SHARP SERVICE MANUAL

FLOPPY DISK DRIVE

MODEL FDD-412A/B

CONTENTS

SHARP CORPORATION

CONTENTS THIS MANUAL

This manual provides service and all maintenance and service information to support the slim, 2-side double-density floppy disk drive FDD-412A and FDD-412B.
Before attempting any service or repairs, take time to familiarize yourself with this manual to make your servicing easier and more efficient.
Currently this floppy disk drive use as bellow mentioned model. Also intentionaly will be use to other model.

UNIT NAME	PARTS CODE	APPLIED PRODUCT MODEL
FDD-412A	DUNTK3010SCZZ	Office computer HAYAC-2900 SYSTEM CO2900E CO2902E HAYAC-3900 SYSTEM CO3906E CO3900E CO3902E CO3903E CO3904E CO3905E CO3906E CO3907E Personal computer MZ1F05 POS system OM18FD1
FDD-412B	DUNTK3011SCZZ	HAYAC-2900 SYSTEM CO2900E Personal computer MZ1F05 POS system OM18FD2

CONTENTS

Page

GENERAL

1.1 Overview

The FDD-412A/B floppy disk drive (FDD) is a slim, energy-saving, lightweight FDD that accommodates 2-sided, double-density floppy disks, based on the technologies implemented in the widely used FDD-101A/201/401/102D/402D/403D FDD.

The FDD-412A (Model A) incorporates a VFO, while the FDD-412B (Model B) has no VFO. The user can select either depending on whether there is a controller VFO or not.

The standard specifications of the FDD are as follows:

File protection	:	Transparent
Top cover color	:	Black
Door lock	:	Electromagnetic door lock mechanism

1.2 Features

(1) Slim lined

The body is only half as wide as conventional types. This makes it possible to install 2 units in a space for a single conventional type.

(2) Lightweight

The FDD weights 3.5 kg or less.

This weight is about 70% of that of our existing models, making handling procedures much easier.

(3) Field-proven brushless direct drive system

Our field-proven brushless direct drive system is implemented in a narrower enclosure.

This system is much more reliable than the belt system or brush-based direct drive system. Without any parts to be replaced periodically, the system is of a complete maintenance-free design.

There is no need to distinguish 50Hz and 60Hz in frequency.

(4) Convenient VFO connecting interface

Up to 4 FDDs can be connected to the controller. If a system configuration includes one model A FDD, all FDDs can be connected to the VFO interface regardless of the other three being of model A or B. This promises configurations of high cost-performance.

(5) 2-DC power supply

A 2-DC power supply system has replaced the 3-DC power supply system. This has reduced the average power consumption to about 57% of that of our existing models.

(6) LSI-based circuitry

Dedicated LSIs constitute the greater part of circuitry. Without any parts to be replaced periodically, higher reliability and much better maintenability can be realized.

(7) Electromagnetic door lock/unlock mechanism

The controller is equipped with an electromagnetic door lock/unlock mechanism that prevents an inadvertent opening of the door during operation.

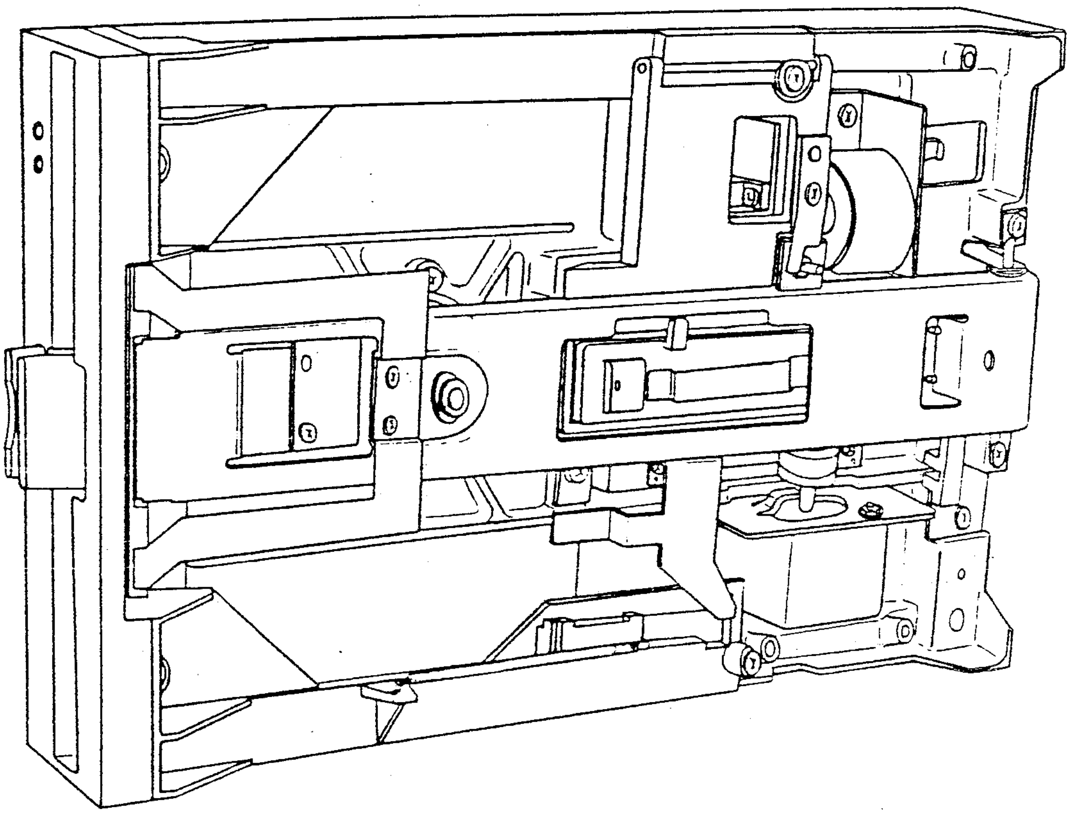


Fig. 1.1 Outside View of FDD-412A/B Floppy Disk Drive

2. PRINCIPLES OF OPERATION

2.1 Outline

The FDD (floppy disk drive) is a device that writes and reads data to and from the floppy disk.

As shown in Fig. 2.1, a floppy disk has 77 concentric "tracks" on either surface (i.e., 154 tracks on both sides). Data is sequentially recorded on each track. A carriage has one magnetic head on each side respectively, and read/write data. It moves radially, processing data on the tracks.

To write or read data to or from a given location on the floppy disk, the following steps are required:

(1) The magnetic head and recording medium are given a relative velocity.

(2) The magnetic head is positioned over the target track.

(3) The target data is searched from among numerious data records written on that track.

(4) The data is read from or written onto the record.

These operations and their control are shared by the FDD and FDC (floppy disk controller). Each of the above steps is further explained below.

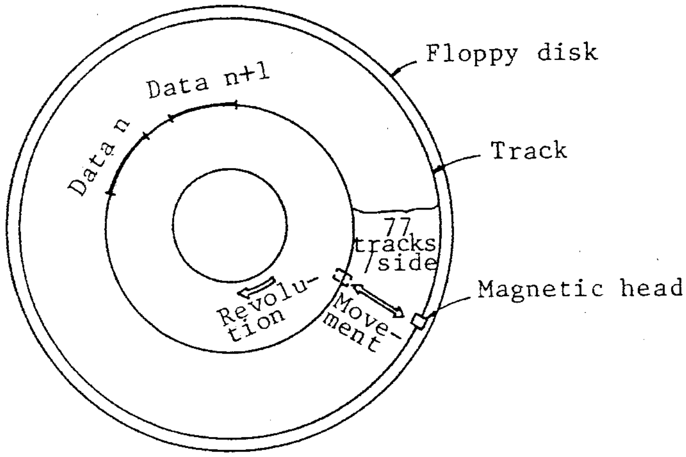


Fig. 2.1 Floppy Disk

(1) The magnetic head and recording medium are given a relative velocity.

Data is sequentially recorded (i.e., in bit-series) on floppy disk. For data processing, it then becomes necessary to move the magnetic head relative to the medium. This is achieved by rotating the floppy disk. The motion is provided by an FDD spindle motor, which rotates at a constant speed for correct reading.

Applying power to the FDD rotates the spindle motor. With a floppy disk inserted and the door closed, the disk is secured to the spindle, ready for revolutions. The magnetic heads are fixed to the FDD. As the floppy disk rotates, a relative velocity is produced between the heads and the disk.

The floppy disk has an index hole to determine the start point on each track. The FDD senses the index hole. When the disk rotation is found normal, the FDD enters a ready state and can be subject to control from the FDC.

(2) The magnetic head is positioned on the target track.

The magnetic head is then positioned on the target track among many concentric tracks. The positioning is done by moving the head radially. How far the head should move is calculated by the FDC as the positional difference between the current track and the target track. The FDD receive pulses indicating the amount of magnetic head relocation. The FDD has a step motor to which the magnetic heads are secured. One pulse causes the head to move by 1 track.

In this manner, the head is positioned on the target track.

(3) The target record is searched.

When positioned on the target track, the head reads out data from the track.

To minimize wear, the FDD is designed so that the head comes in contact with the disk surface only upon reading/writing. The FDC issues a HEAD ENGAGE command to the FDD for contact between the head and the disk.

The FDD reads out the data from disk and sends it to the FDC.
The FDC searches the target record as it reads data on the track.
One record consists of an ID part (identifier) and a data part.
Reading the ID part reveals whether or not the record is what is needed.

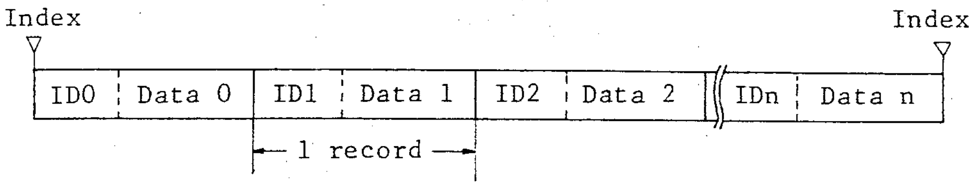


Fig. 2.2 Data Arrangement on Track

(4) The data is read out or written in.

When the target record is found, data is written to or read from the data part.

The magnetic heads of the FDD are used for both heading and writing. When a write command is given by the FDC, a current flows in the magnetic head and all readout operations are suppressed.
That is, the FDD performs either a write or readout operation at any one time, not both simultaneously. The data read from disk is of analog waveshapes, which are digitized by the FDD for transmission to the FDC.

The model A FDD incorporates a VFO circuit, and is capable of demodulating the data that was modulated by the so-called FM/MFM magnetic recording method.

2.2 Configuration

The FDD is composed of a drive mechanism and the control electronics, as shown in Fig. 2.3 (on page 14).

2.2.1 Drive Mechanism

The drive mechanism consists of the following:

(1) Carriage

The carriage is equipped with 2 magnetic heads for side 0 and side 1.

For movement, the carriage receives step motor revolutions via a steel belt.

(2) Step motor

The step motor turns in response to the STEP-N signal from the controller.

Step motor revolutions are transmitted via the steel belt to the carriage which positions the magnetic head at a given location.

(3) Spindle motor

The floppy disk medium is press-fit to the spindle motor by a collet for rotation.

The rotational speed of the spindle motor is 360 rpm.

(4) Head load solenoid

By sensing the presence and absence of the HEAD ENGAGE-N signal from the controller, the head load solenoid engages the magnetic head (to enable reading/writing) and disengages it (to disable reading/writing).

(5) Index sensor

Two pairs of LEDs and phototransistors are installed to tell whether the recording medium is 1-sided or 2-sided.

The distinction is accomplished by detecting an index hole on the medium for index pulse generation.

(6) 0 track sensor

With respect to the carriage position, the 0 track sensor detects the magnetic head at track 0 position and causes the TRACK00-N signal to be generated.

(7) Auto-ejector mechanism

The auto-ejector mechanism consists of a spring-and-latch arrangement capable of the following functions:

(a) Upon insertion of floppy disk

The floppy disk, upon insertion, is not latched and is rejected until it is in place.

This function accurately positions the floppy disk center hole to the spindle, protecting the hole from damage and preventing track dislocation.

(b) Upon disk removal

Opening the door allows part of the floppy disk to pop out of the FDD.

(8) File protection

The file protection mechanism comprises a pair of LED and phototransistor, and a logic circuit. It checks if the floppy disk jacket has an inhibit notch. If the notch is found to be present, data write operation is inhibited.

(9) Spindle motor controller

The spindle motor controller is an electronic control circuit that keeps the brushless direct drive motor turning at a constant speed by accommodating load changes.

(10) Electromagnetic door lock mechanism

In this mechanism, an electromagnetic door lock solenoid is driven by a control signal from the FDC to lock/unlock the door.

2.2.2 Control Electronics

(1) The control electronics consists of control logic circuitry comprising read/write control circuits, and controls the FDD according to instructions from the FDC. With model A, the VFO circuit is part of the control electronics.

(2) The VFO circuit modifies in timing the signals read out from the floppy disk, divides them into clock and data signals, and transmits them to the FDC.

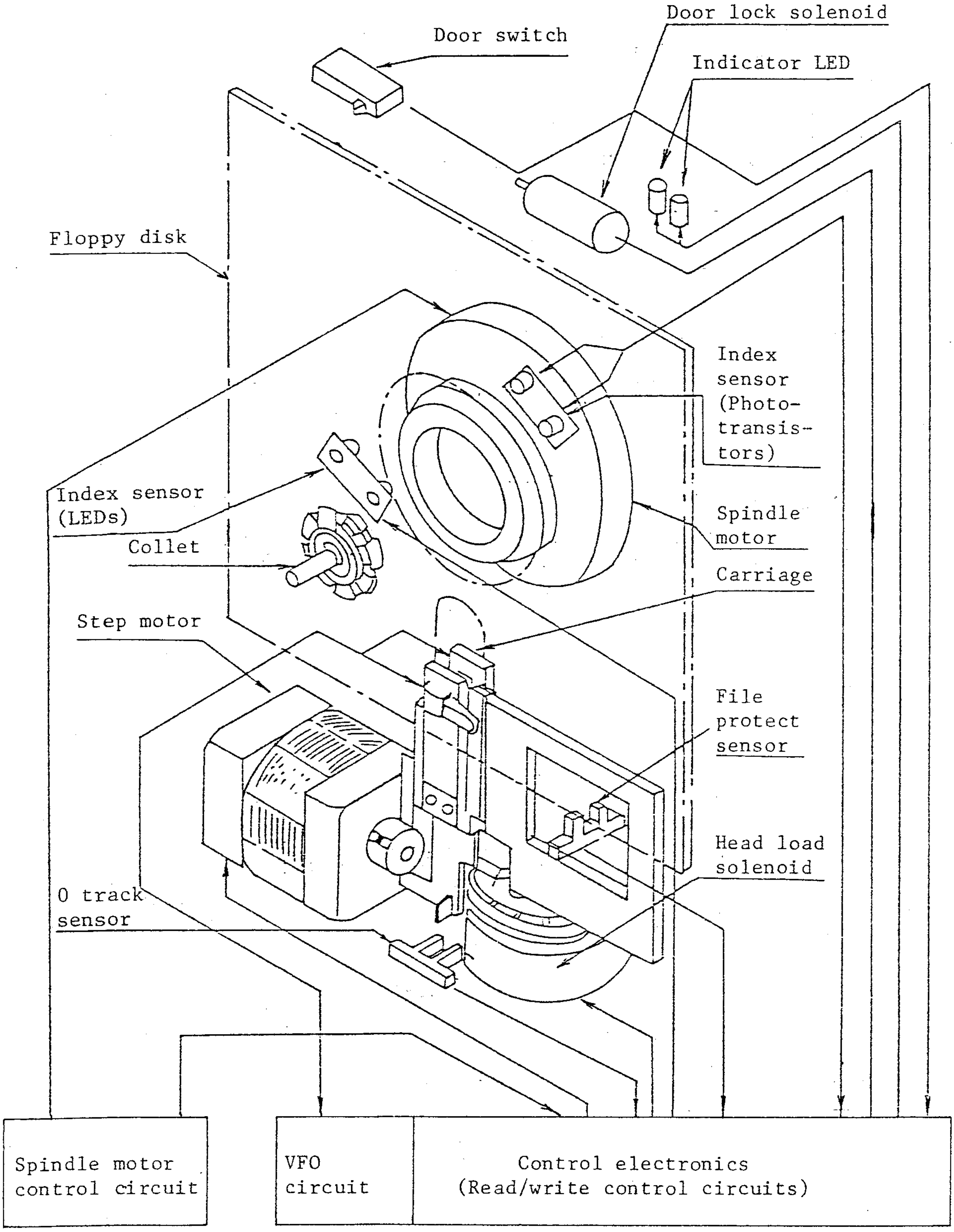


Fig. 2.3 Device Composition

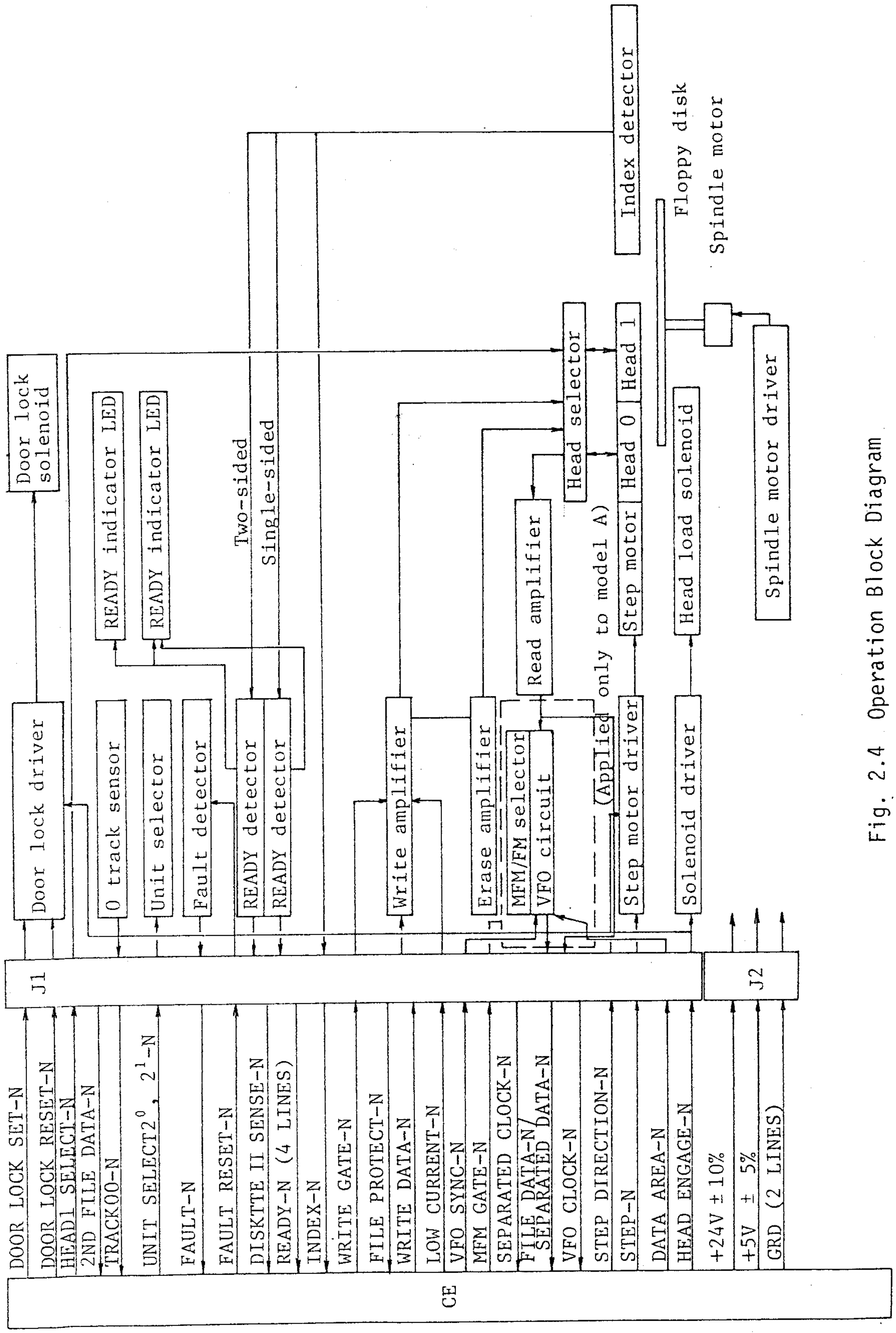


Fig. 2.4 Operation Block Diagram

2.3 Specifications

2.3.1 Performance Specifications

Table 2.1 Performance Specifications

Item			Performance: Single-sided Single Density	Performance: Two-sided Single Density	Performance: Two-sided Double Density
Storage capacity KB	Sector format	1	359	718	1440
		8	–	606	1212
		26	243	493	985
Data transfer rate K bits/sec			250	250	500
Recording density BPI			3268	3268	6816
Track density TPI			48	48	48
Number of cylinders			–	77	77
Number of tracks			77	154	154
Encoding method			FM	FM	MFM
Disk rotational speed rpm			360		
Mean latency ms			83		
Access time ms					
	Track to track		3		
	Average (excluding setting)		76		
	Setting		35		
Head loading time ms			50		
Starting time sec			1		

2.3.2 Power Requirements

Table 2.2 Power Requirements

Number of configured units			1		2		3		4	
Model type			A	B	A	B	A	B	A	B
Current consumption	DC+24V ±10%	Max.	1A		2A		3A		4A	
		Avg.	0.5A		0.7A		0.9A		1.1A	
	DC+5V ±5%	Max.	1.3A	1.1A	2.6A	2.2A	3.9A	3.3A	5.2A	4.4A
		Avg.	1.1A	0.9A	2.1A	1.8A	3.1A	2.7A	4.1A	3.6A
Power consumption	Max.		31W	30W	61W	60W	92W	90W	122W	120W
	Avg.		18W	17W	28W	26W	37W	35W	47W	45W

Note 1: The current and the power consumption data include the period from power application, to the time the spindle motor has reached a normal speed.

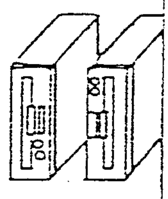
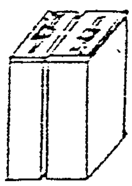
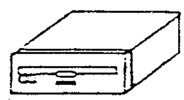
Note 2: The average current and power consumption data are for reference, based on the mean voltage and average environment. The conditions under which the data were collected are as follows:

- IBM's or Hitachi Maxell's medium is mounted on the FDD.
- All FDDs connected to the FDC are powered on.
- The FDC is performing a seek operation on one FDD with its head loading on the medium.

Note 3: The power voltage is regulated on the FDD side.

2.3.3 Mounting Specifications

Table 2.3 Mounting Specifications

<table>
<tr><th colspan="4">Item</th><th colspan="3">Specification</th></tr>
<tr><td colspan="3">Outside dimensions</td><td>mm</td><td colspan="3">57(W) × 217(H) × 330(D) (Note 1)</td></tr>
<tr><td colspan="3">Weight</td><td>kg</td><td colspan="3">3.5 max.</td></tr>
<tr><td colspan="3">Vibrations</td><td>G</td><td colspan="3"></td></tr>
<tr><td></td><td colspan="3">Under operation</td><td colspan="3">0.25 (5 ∿ 20Hz)</td></tr>
<tr><td></td><td rowspan="2">Under non-operation</td><td colspan="2">Vibration</td><td colspan="3">5 (5 ∿ 20Hz)</td></tr>
<tr><td></td><td colspan="2">Impact</td><td colspan="3">20 (Rise time : 10 ms min.
Pulse width: 20 ms max.)</td></tr>
<tr><td colspan="4">Peak value of allowable DC line input noise (rise/fall time: 500 ns min.)</td><td colspan="3"></td></tr>
<tr><td></td><td colspan="3">DC +24V line</td><td colspan="3">300mV</td></tr>
<tr><td></td><td colspan="3">DC +5V line</td><td colspan="3">100mV</td></tr>
<tr><td colspan="4" rowspan="2">Mounting direction</td><td>Vertical</td><td>Upright</td><td>Horizontal</td></tr>
<tr><td>
Two ways</td><td>
Two ways</td><td>
PCI side down</td></tr>
</table>

Note 1: The outside dimensions exclude a handle protrusion of 10 mm.

2.3.4 Environment Specifications

Table 2.4 Environment Specifications

Item		Specification
Ambient temperature °C		See Note 1.
	Under operation	10 ∿ 43
	Under non-operation	-10 ∿ 50
	Under transit	-30 ∿ 60
Relative humidity %RH		
	Under operation	20 ∿ 80
	Under non-operation	8 ∿ 90
	Under transit	8 ∿ 90
Wet bulb temperature °C		29 max., without dew condensation

Note 1: The temperature gradient must be 10°C/Hr or less.

2.3.5 Reliability Specifications

Table 2.5 Reliability Specifications

Item		Specification
MTBF (under operation) (Hr)		10000
MTTR (Hr)		0.5
Life		5 years or 15,000 POH (whichever is shorter)
Error rates		
	Recovery times/bit	10^{-9}
	Non-recovery times/bit	10^{-12}
	Seek times/bit	10^{-6}
Medium life pass/track		3.5×10^{6}
Recommended medium		IBM DISKETTE I, II, IID; or HITACHI MAXELL FD1, FD2, FD2-D

2.4 Recording Media

2.4.1 Medium Type

(1) As shown in Fig. 2.5, the recording media for the FDD is floppy disk composed of flexible, oxide-coated mylar sheet , housed in a dedicated jacket.

Except for the index hole position, both the single-sided and two-sided floppy disks are of the same shape.

(2) IBM's floppy disks (IBM DISKETTE I, II, IID) are the standard recording media.

(3) To use the file protection feature requires an inhibit notch, the specifications of which are shown in Fig. 2.5.

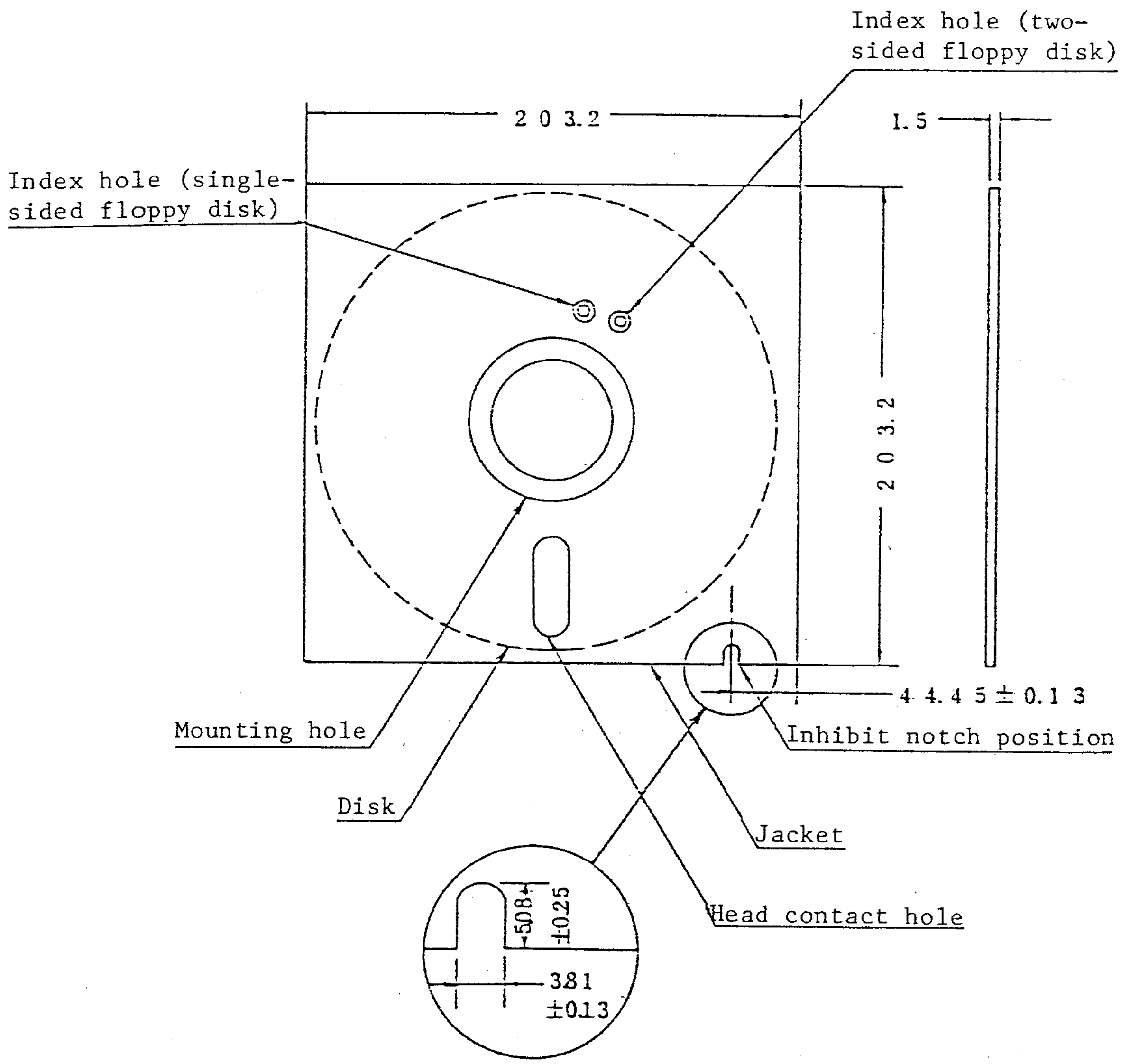


Fig. 2.5 Recording Medium

2.4.2 Handling of Recording Media

Given below are general cautions for handling the recording media:

(1) Do not pierce the medium jacket with a pin, put a clip on it, or write directly on it in pencil.

(2) Store recording media in a dust-free place.

They should always be housed in their respective cases and placed horizontally or vertically. In horizontal storage, do not stack the disks more than five high so as to prevent deformation.

(3) The recording medium should be under the following ambient conditions for at least 5 minutes before use:

Temperature	:	10 ∿ 43°C
Relative humidity	:	20 ∿ 80%
Maximum wet bulb temperature	:	29°C, without dew-condensation

(4) Do not touch or wipe with solvent the oxide-coated medium surfaces.

(5) Keep recording media away from magnetic fields.

(6) Do not expose recording media to heat or directly to the sun.

2.4.3 Recording Methods

The FDD utilizes two recording methods: FM and MFM.

(1) FM (frequency modulation) method

Flux change does not occur at data '0' but takes place at data '1'. Clock bits are inserted between data items to indicate the range of data presence (bit cell).

(2) MFM (modified frequency modulation) method

Flux change does not occur at data '0' but takes place at data '1'. Clock bits are inserted only where 0's are continuous.

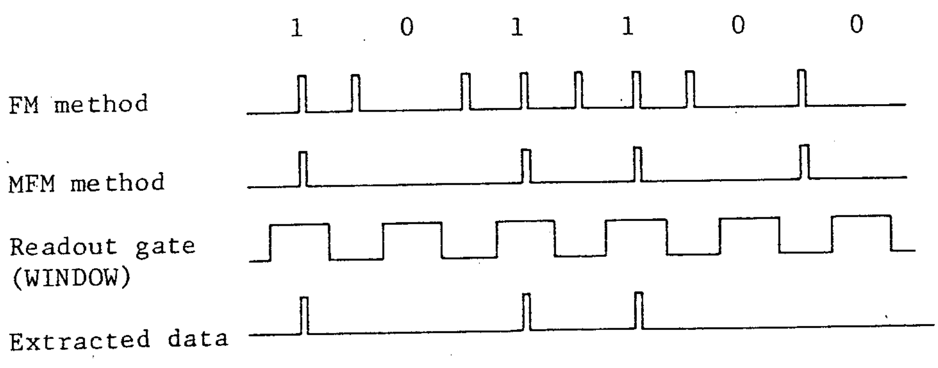


Fig. 2.6 MF Method and MFM Method

(3) Comparison of FM method with MFM method

Table 2.6 A Comparison of FM Method with MFM Method

Recording Method	Bit Cell (μs)	Data Transfer Rate (KB/s)	Pulse Interval (μs)	Frequency (kHz)	Frequency Ratio
FM	4	250	2 4	250 125	2:1
MFM	2	500	2 3 4	250 166.7 125	2:1

2.4.4 Data Format

While the floppy disk needs to be initialized in advance to the predetermined format, the data format must meet the following requirements.

IBM-based data formats will meet all of them.

(1) Length of ID part ≦ 224 μs

(2) Length of gap across ID part to data part (exclusive of VFO area) ≧ 512 μs.

(3) Length of gap across data part to ID part (exclusive of VFO area) ≧ 544 μs.

(4) The VFO area should be of 6 bytes or more for the FM method and 12 bytes or more for the MFM method, with the $(00)_{16}$ pattern.

(5) The gap pattern should be $(FF)_{16}$ for the FM method and $(4E)_{16}$ for the MFM method.

(6) The gap following the CRC to be updated upon writing to the data part should be of 1 byte or less.

(7) Writing solely onto the ID part (partial write) should not be done.

As an example of double density recording onto the floppy disk, Fig. 2.7 shows an IBM format and Table 2.7 fives the contents of the format.

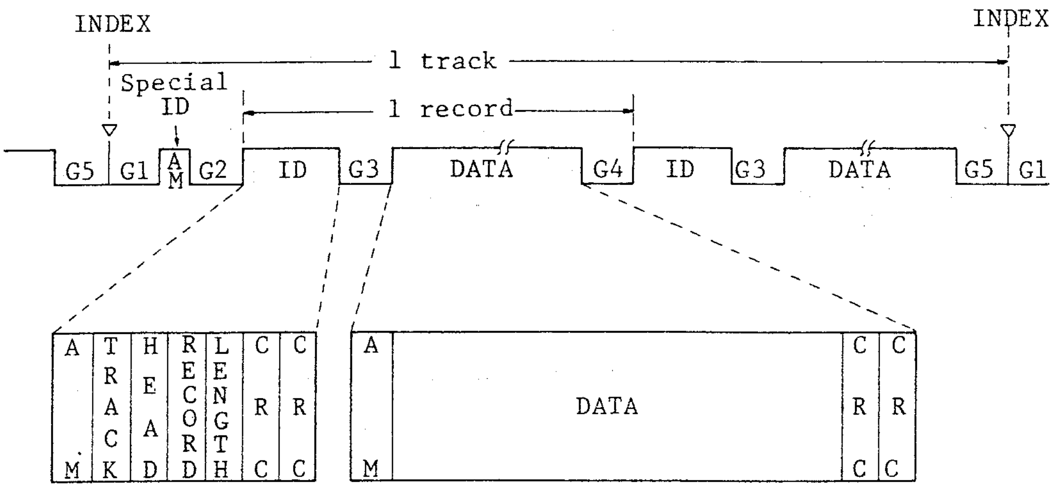


Fig. 2.7 IBM Data Format

Table 2.7 Contents of IBM Data Format

Position		Track Position	Length (Byte)	Contents B: Byte
G1 gap		CYL0 HD0	46	(FF) × 40B + (00) × 6B
		CYL0 HD1 CYL1∿76 HD0/1	92	(4E) × 80B + (00) × 12B
Special ID		CYL0 HD0	1	(FC)
		Other tracks	4	(C2)(C2)(C2)(FC)
G2 gap		CYL0 HD0	32	(FF) × 26B + (00) × 6B
		Other tracks	62	(AE) × 50B + (00) × 12B
ID	AM	CYL0 HD0	1	(FE) Missing clock
		Other tracks	4	(A1)(A1)(A1)(FE) Missing clock
	TRACK	All tracks	1	(00) ∿ (4C); Track number
	HEAD	All tracks	1	(00) or (01); Head number
	RECORD	All tracks	1	(01) ∿ (1A); Record (secotr) number
	LENGTH	All tracks	1	(00)=128B (01)=256B; data part length
	CRC	All tracks	2	Check byte
G3 gap		CYL0 HD0	17	(FF) × 11B + (00) × 6B
		All tracks	34	(4E) × 22B + (00) × 12B
Data part	AM	CYL0 HD0	1	(FB) or (F8); Missing clock
		Other tracks	4	(A1)(A1)(A1)(FB) or (A1)(A1)(A1)(F8); Missing clock
	DATA	CYL0 HD0	128	FM method
		Other tracks	256	MFM method
	CRC	All tracks	2	Check byte
G4 gap		CYL0 HD0	33	(FF) × 27B + (00) × 6B
		Other tracks	66	(4E) × 54B + (00) × 12B
G5 gap		CYL0 HD0	TYP247	(FF) × 247B
		Other tracks	TYP598	(FF) × 598B

2.5 Logic Operations

2.5.1 Sensor-Related Operations

(1) The following 5 sensors are provided inside the FDD to sense various portions for status:

Table 2.8 Names and Functions of Sensors

No.	Sensor Name	Detection System	Function	Relation to Interface Signal
1	TRACK 00	Photo-transistor	Detects head position status.	TRACK 00-N
2	FILE PROTECT	Photo-transistor	Detects a write-inhibited disk.	FILE PROTECT-N
3	INDEX 1	Photo-transistor	Detects the single-sided disk index hole.	INDEX-N and DISKETTE II SENSE-N
4	INDEX 2	Photo-transistor	Detects the two-sided disk index hole.	
5	DOOR SWITCH	Microswitch	Checks if the door is closed.	–

(2) Track 00 sensor

The track 00 sensor checks if the magnetic head is positioned on the outermost track of the medium. The sensing is done by the carriage's tab coming in between the LED and the sensor for emission interruption. This operation is used to generate the reference signal for the FDC.

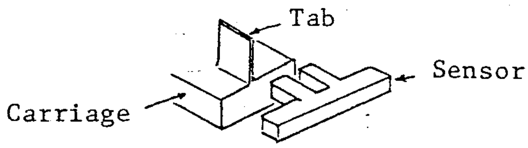


Fig. 2.8 Track 00 Sensor

(3) File protect sensor

The file protect sensor senses the presence or absence of the inhibit notch on the medium. Upon sensing, the sensor tells the FDC whether or not writing is available, simultaneously controlling if the FDD write circuit should be operable.

When writing is to be done, use a medium with no inhibit notch or put a write permission label on the medium.

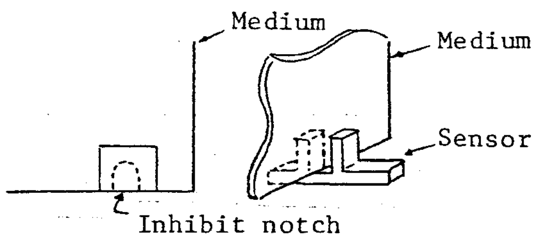


Fig. 2.9 File Protect Sensor

(4) Index-1/2 sensor

The index-1/2 sensor senses the index hole on the medium.
It informs the FDC of the track start point, automatically recognizes the medium type (single-sided or two-sided), and checks the medium for rotation status.

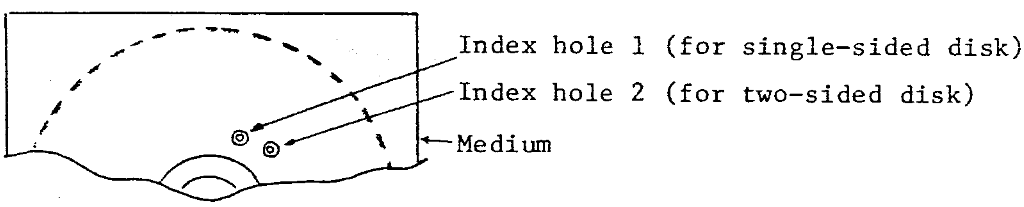


Fig. 2.10 Index Hole

(5) Door switch

The door switch checks if the FDD door is closed.

If the door is found open, the FDD is kept from entering the ready state because the medium is not rotating.

2.5.2 Seek Operations

(1) Interface signals

Table 2.9 Interface Signals for Seek Operation

No.	Signal Name	Function	Remarks
1	STEP-N	Pulse signal to direct track movement. One pulse causes 1 track for movement.	
2	STEP DIRECTION-N	Level signal to direct movement direction. H : Centrifugal movement L : Centripetal movement	

(2) Outline of operation

Operation flow	Condition	Description
Command from FDC	STEP-N STEP DETECTION-N	The FDC calculates the positional difference between the current and new track positions, and signals the absolute amount of displacement.
⇩ Operation mode check in FDD	Not in write mode	Seek operation is inhibited for 580 μs following WRITE GATE-N (directing write mode).
⇩ Step motor switched for exciting phase control		Of the 4 phases of step motor winding, 2 phases are driven at a time.
⇩ Steel motor driven	3.6°/step	
⇩ Steel belt rotated		
⇩ Carriage moved	approx. 0.5 mm/step	
⇩ Head positioned		

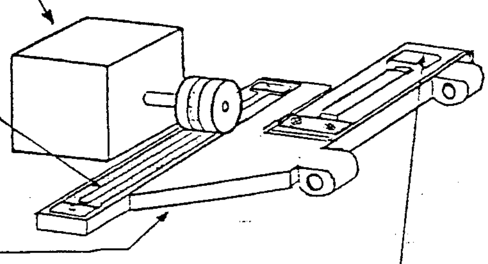


Fig. 2.11 Outline of Seek Operation

(3) Seek circuit block diagram

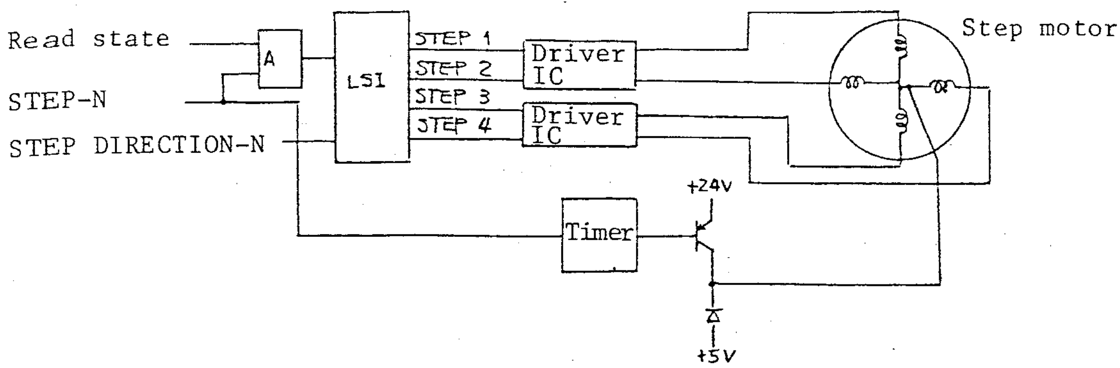


Fig. 2.12 Seek Circuit Blodk Diagram

(4) Circuit operation

(a) The STEP signal is used to excite 2 phases at a time in STEPs 1∿4.

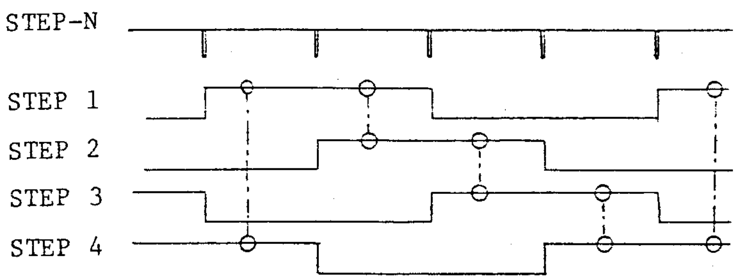


Fig. 2.13 Step Motor Excitation Timing

(b) Upon seek operation, the step motor needs a large current, but requires a small hold current to flow for displacement prevention once the seek operation is completed.

In seek operation, the motor is driven at +24V, and at +5V after completion of the operation. This scheme requires less power consumption. The following points should be noted:

(i) About 60 ms after a head engagement, the motor is driven at +24V for prevention of dislocation attributable to the load.

(ii) About 40 ms after the last STEP-N signal, the motor is driven at +24V for position stabilization (settling).

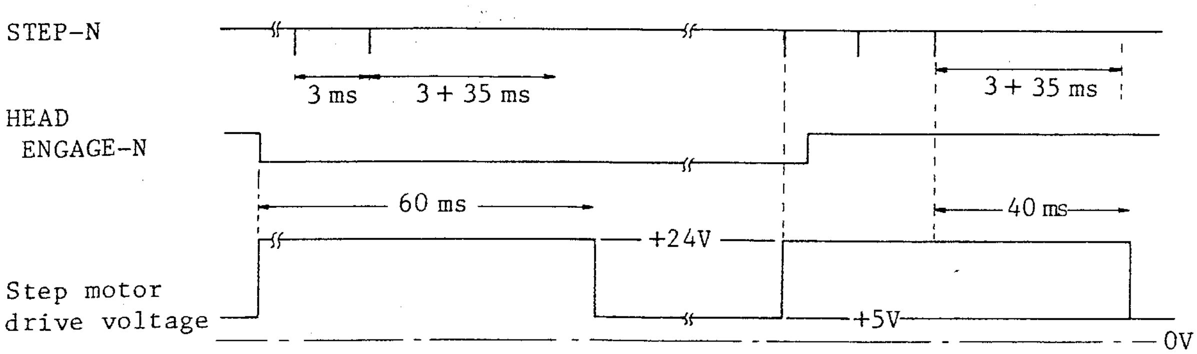


Fig. 2.14 Step Motor Drive Voltage Switchover

2.5.3 Magnetic Head Composition and Its Related Operations

(1) Magnetic head composition

As shown in Fig. 2.15, the magnetic head has 2 gaps as a read/write head and an erase head. The magnetic head is housed in a slider and secured with a "gimbals" mechanism to the carriage.

Table 2.10 shows how the magnetic head moves and what it features.

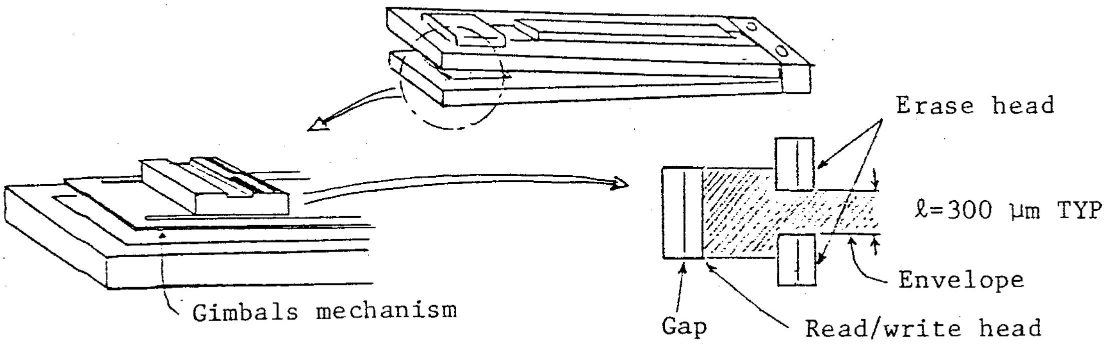
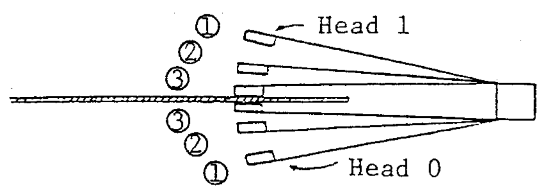


Fig. 2.15 Magnetic Head Composition

Table 2.10 Movements and Features of Magnetic Head

Item	Contents
Name	Tunnel-erase type magnetic head
Features	(1) The read/write head and erase head are far apart and do not affect one another. (R/W current:Erase current = 1:10) (2) Envelope waveshapes, with both sides erased by the the erase head, are much better. (3) The read/write head and erase head need to be electrically corrected in operational timing. (ERASE GATE) (4) The disk sides and the heads come into stable contact under a "pinching" spring pressure from the gimbals mechanism.
Head on/off mechanism	 ① The FDD door is open. ② The FDD door is closed. ③ The head is loaded on.

(2) Tunnel erase system

The tunnel erase system is used to guarantee data compatibility.

The following are the reasons why this system is needed:

(a) In most magnetic recording implementations, writing new data automatically erases old data. The erase head is not specifically needed.

(b) But the floppy disk is often subjected to read/write operations as it is exchanged between FDDs.

(c) Assume that there is no erase head and that data is recorded as shown in Fig. 2.16 (A).

(d) The disk is then subjected to writing on another FDD. At this time, the head is a bit out of position, and the writing is done as shown in Fig. 2.16 (B).

(e) When data of (B) is read by the magnetic head shown in Fig. 2.16 (C), the old data (remaining data) shaded in (C) and new data are read in together. The old data causes noise, resulting in read error.

(f) To provide for head displacement on different FDDs, both sides are erased by an erase head for removal of old data, as shown in Fig. 2.16 (D). In this way, the tracks always contain the latest data and can prevent noise due to remaining data.

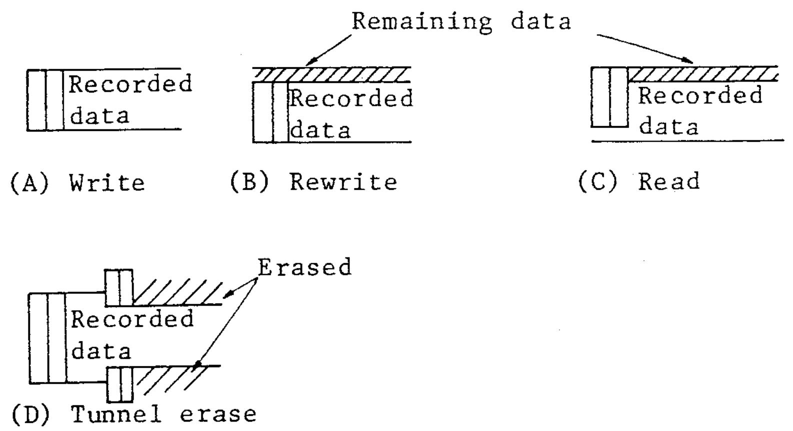


Fig. 2.16 Tunnel Erase System

2.5.4 Data Write Operation

(1) Interface signals

Table 2.11 Data Write Interface Signals

No.	Signal Name	Function	Remarks
1	WRITE GATE-N	Instructs a write operation. The FDD has a current flow in the heads while this signal is on.	
2	WRITE DATA-N	Data for recording on medium; information modulated by FM/MFM method.	
3	LOW CURRENT-N	Switches write current levels between outer and inner tracks. Tracks 0∿43 (large current): 'H' level Tracks 44∿76 (small current): 'L' level	
4	HEAD 1 SELECT-N	Selects the head. Head 0: 'H' level Head 1: 'L' level	

(2) Outline of operation

Operation flow	Condition	Description
Command from FDC	WRITE GATE-N WRITE DATA	
⇩ Operation mode checked in FDD	The device must be in ready state, with the head engaged.	'FAULT' is set if the mode is not normal.
⇩ ERASE GATE generated	(Timing is shown below.)	The FDD generates a signal to operate the erase head.
⇩ Data written		Data and CRC data are recorded.

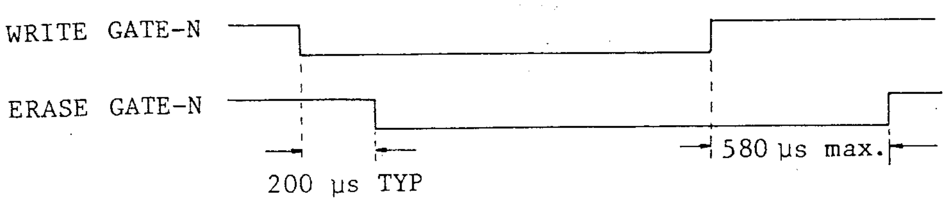


Fig. 2.17 Outline of Write Operation

(3) Write circuit block diagram

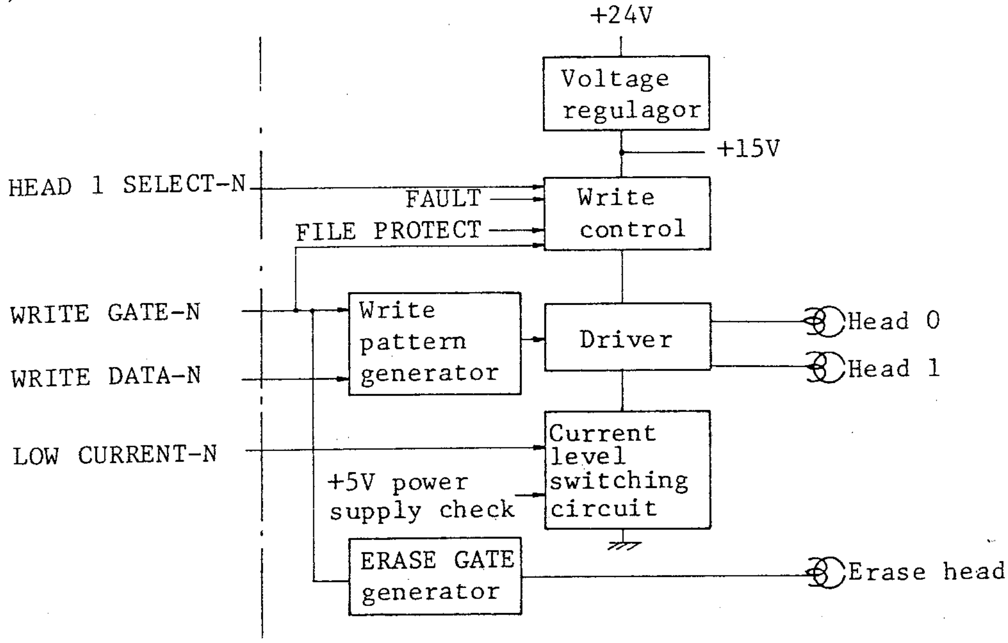


Fig. 2.18 Write Circuit Block Diagram

(4) Circuit operations

(a) Write pattern generation

The FDC modulates data in the FM/MFM mode and sends it to the FDD in pulses. The FDD converts pulse waveshapes into magnetic head current waveshapes.

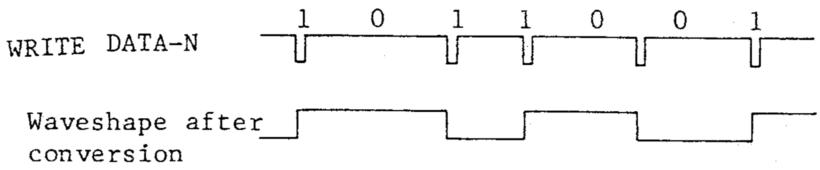


Fig. 2.19 Write Pattern Generation (in MFM Mode)

(b) ERASE GATE generation

To use the erase gate system, the erase head starts operating a little later than the read/write head.

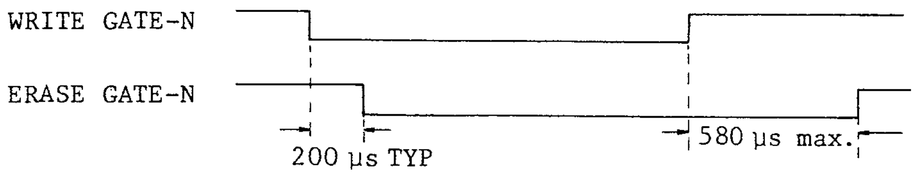


Fig. 2.20 ERASE GATE Generation

2.5.5 Data Read Operation

(1) Interface signals

Table 2.12 Data Read Interface Signals

No.	Signal Name	Function	Remarks
1	LOW CURRENT-N	Switches read amplifier filter levels between outer and inner tracks. Tracks 0∿43 : 'H' level Tracks 44∿46: 'L' level	Same as the one used in write operation.
2	MFM GATE-N	FM/MFM switch signal FM mode : 'H' level MFM mode: 'L' level	Required for model A FDD alone (with VFO).
3	VFO SYNC-N	Instructs the VFO circuit to operate, going to 'L' level in data read operation.	
4	DATA AREA-N	Goes to 'L' level in reading the data part, during which time the VFO is held in synchronization.	

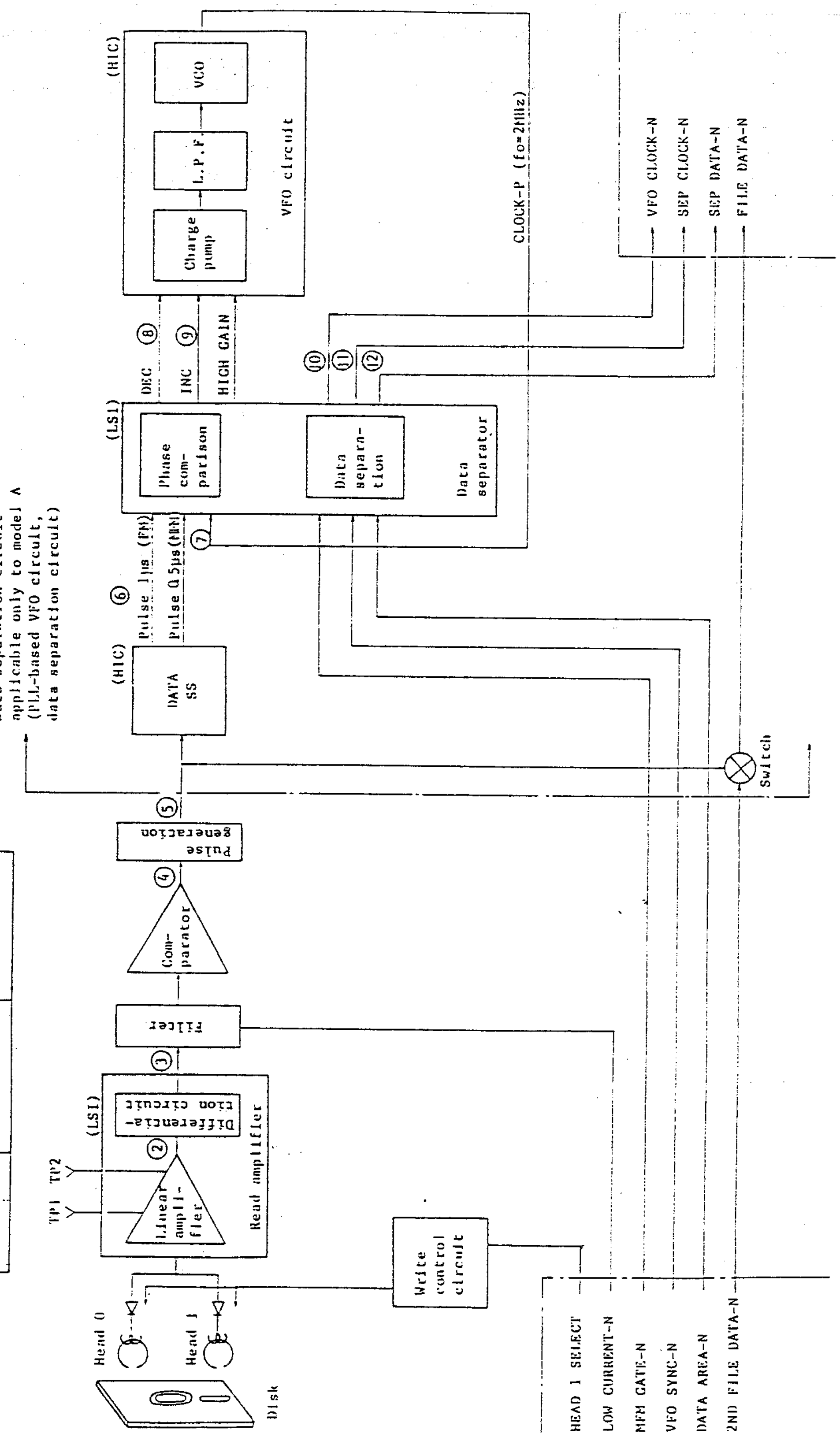
(2) Outline of operation

Operation flow	Condition	Description
Command from FDC	(LOW CURRENT-N)	... In reading data from inner tracks (44~76).
⇩	(MFM GATE-N)	... In reading MFM data.
VFO circuit pulling in	VFO SYNC-N	The data read out is automatically transferred to the FDC.
⇩		
Command from FDC	DATA AREA-N	... The FDC gives a command after detecting AM in the data part.
⇩		
Data read out		With the VFO provided (model A), data and clock bits are automatically separated for transmission.

Fig. 2.21 Outline of Read Operation

(3) Read circuit block diagram

The numbers encircled in the figure correspond to the time charts of Figs. 2.23 to 2.26.



(For reference)

Envelope	Condition	
Average read out voltage for TP1/2 differential analog waveshape	Track $(00)_{16}$ Pattern $(00)_{16}$FM	320mV p-p
	Track $(4C)_{16}$ Pattern $(FF)_{16}$FM	100mV p-p

Fig. 2.22 Write Circuit Block Diagram

(4) Read circuit operation

(a) Read circuit operation flow

In the analog waveshapes (2 below), each peak position corresponds to a flux change (i.e., data position).

These data positions should be converted to pulses, as shown in write waveshapes 1. To do this, differentiation is first performed for conversion such that the flux change positions on the wave intersect the 0 level 3. The data is then placed in a comparator (for voltage comparison) and converted to a square wave which is reversed at intersection points on the 0 level 4.

A pulse generator is then used to generate pulses at leading and trailing edges of the square wave 5.

This provides the same readout data as in the write waveshape.

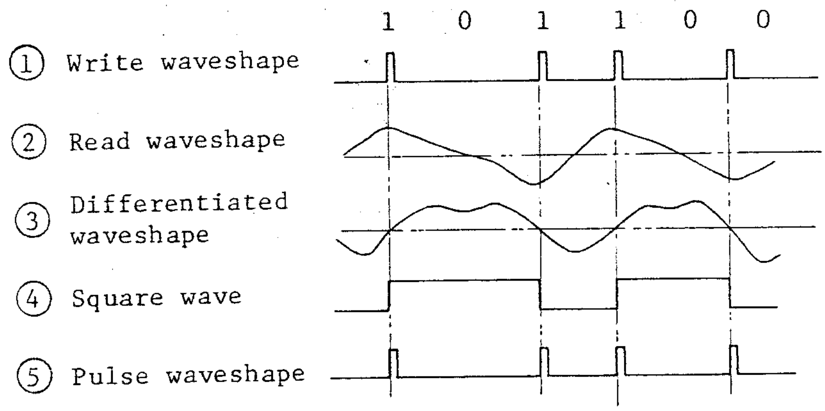


Fig. 2.23 Read Circuit Data Conversion Waveshapes

(b) Read amplifier

The read amplifier consists of a differential amplifier and a differentiation circuit. TP1 and TP2 permit differential signals to be observed directly for effective troubleshooting.

(c) Filter switchover

The LOW CURRENT signal for writing is used as it is. Because inner tracks have higehr bit density than outer tracks, data resolution is increased correspondingly for the inner tracks.

(5) VFO circuit operation (for model A alone)

(a) Objective

Data bits are correctly separated from clock bits in the read data.

(b) Operation

A separation (window) signal (VFO CLOCK) as shown in Fig. 2.24 is generated to gate the read data for generation.

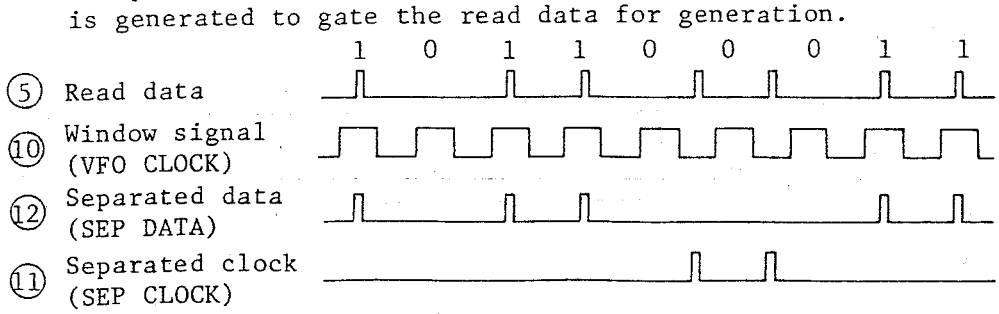


Fig. 2.24 VFO Circuit Operation (in MFM Mode)

(c) Operating principle of VFO

The VFO circuit is intended to generate the window signal. In practice, the intervals between read data vary depending on several factors including medium revolutions. This keeps the window signal from correct separation as a fixed generator output. It becomes necessary for the window signal to synchronize with data interval variations.

This is achieved by a circuit as shown in Fig. 2.25.

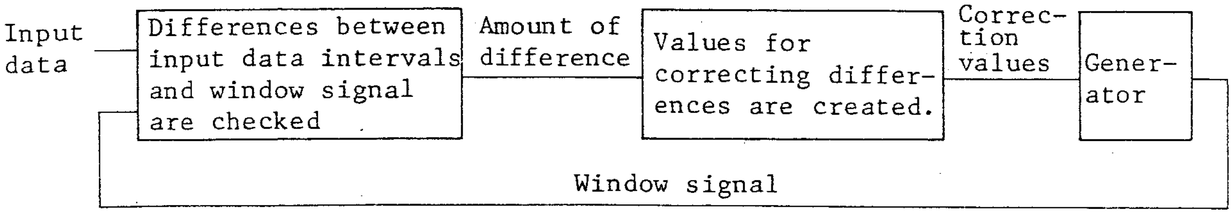


Fig. 2.25 Operating Principle of VFO

(d) Correspondence to block diagram (Fig. 2.22)

(i) Data SS: Converts input data waveshapes into pulse waveshapes for easy comparison in order to verify differences (in FM mode: 1.0 µs-wide pulse; in MFM mode: 0.5 µs-wide pulse).

(ii) Data separator: Compares the generator output and data pulses in phase. For a phase difference, a signal with the pulse width proportionate to the amount of difference is output. The DEC (decrease) or INC (increase) signal is output depending on the phase shift direction (leading or lagging).

(iii) Charge pump/L.P.F.: Produces the control voltage (V_E) for control on the VCO generator output. The voltage is output in proportion to the pulse width (i.e., phase difference) of the DEC or INC signal.

(iv) VCO: This voltage controlled oscillator provides oscillation at frequencies proportionate to the input control voltage (center frequency: 2MHz).

(e) Other operations

(i) HIGH GAIN: Promotes VFO follow-up characteristics. When the VFO SYNC signal is given, it is preferable to complete the follow-up as soon as possible. Once the follow-up is completed, it then is necessary to keep off effects of noise and bit dislocation. This signal turns on the follow-up characteristics.

(ii) 2ND FILE DATA: The FDD equipped with VFO can separate data read by an FDD without VFO by connecting a model B FDD. This signal allows data from a model B FDD to enter the VFO circuit of this FDD.

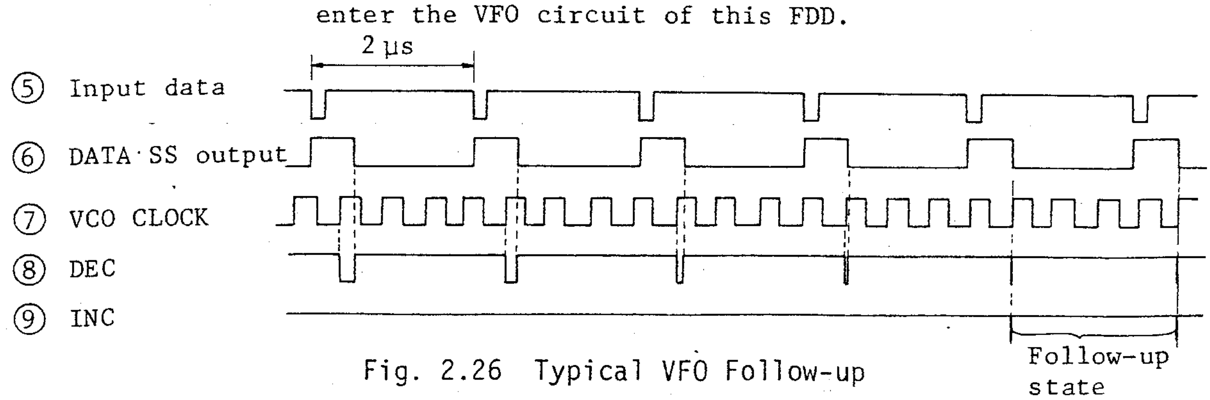


Fig. 2.26 Typical VFO Follow-up

(6) Control over read operation

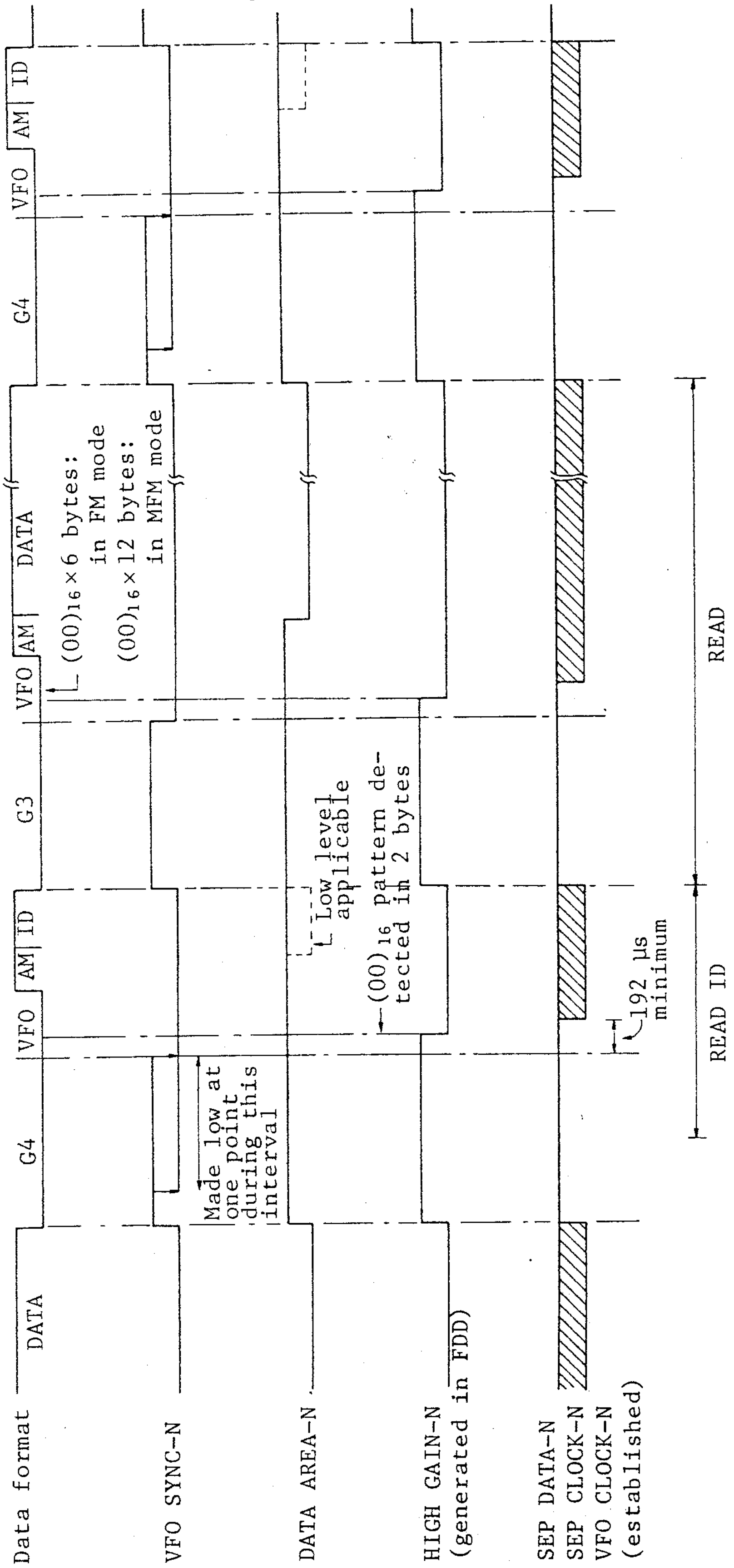


Fig. 2.27 Control over Read Operation (after READ ID)

2.5.6 Operations Related to Spindle Motor Drive Mechanism

(1) Interface signal

None (automatic control initiated upon power application)

(2) Outline of operation

Applying power immediately rotates the spindle motor.
The mechanism automatically keeps the rotational speed constant (360 rpm) through a feedback loop.

(3) Block diagram of spindle motor drive mechanism

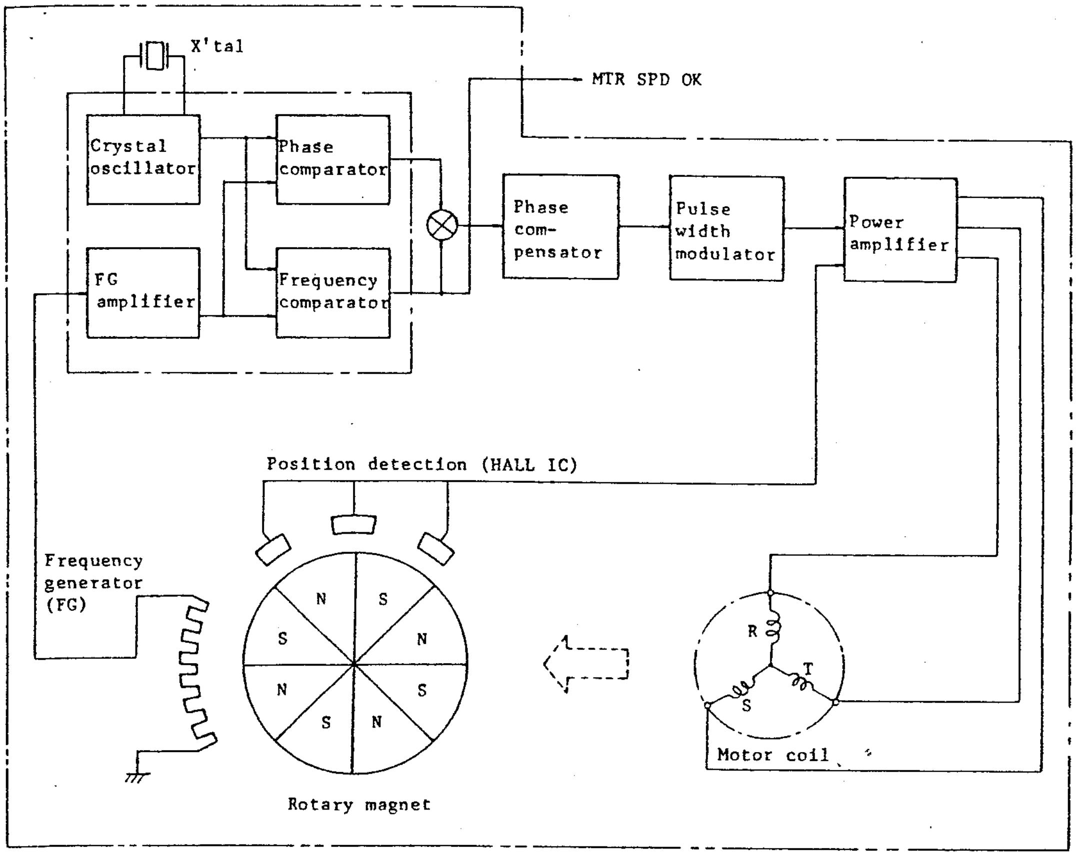


Fig. 2.28 Block Diagram of Spindle Motor Drive Mechanism

(4) Operating principles of spindle motor drive mechanism

(a) Drive section

The S pole of the rotary magnet is detected by a position detecting element (HALL IC). In the setup of Fig. 2.29, H_W detects the S pole. This drives amplifier V_W, allows current I_T to flow, and rotates the rotor.

With the rotor rotating H_W, H_V and H_U detects the S pole in turn to generate drive voltages (Fig. 2.30) for motor drive.

(b) Feedback section

The frequency generator generates frequencies proportionate to the rotor revolutions. The generator output and crystal oscillator output are compared in phase shift and frequency to calculate rotation correction values.

The correction values enter the pulse width modulator via the phase compensator for varying voltages that flow in the motor winding.

This keeps the rotational speed constant.

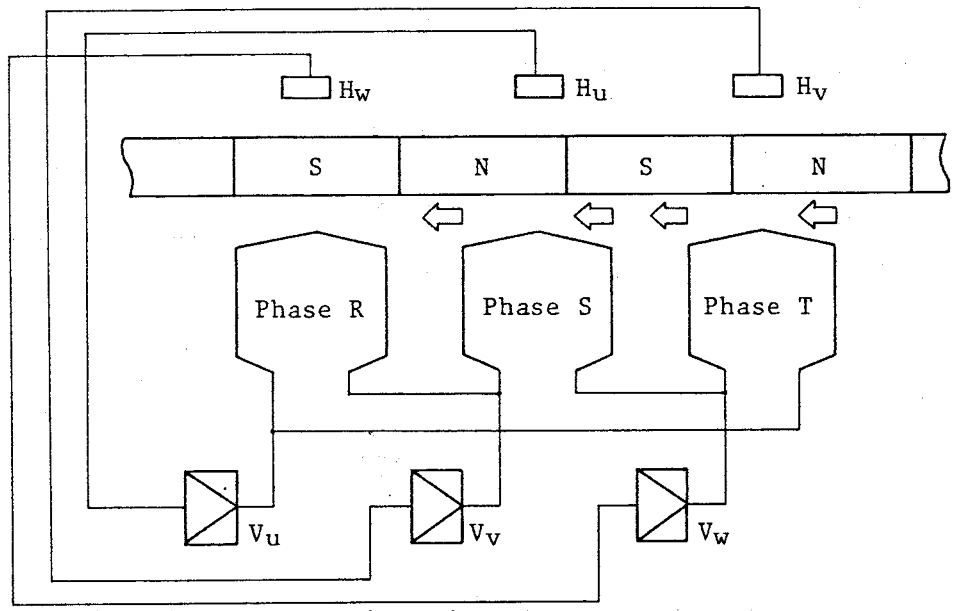


Fig. 2.29 Spindle Motor Operating Principles

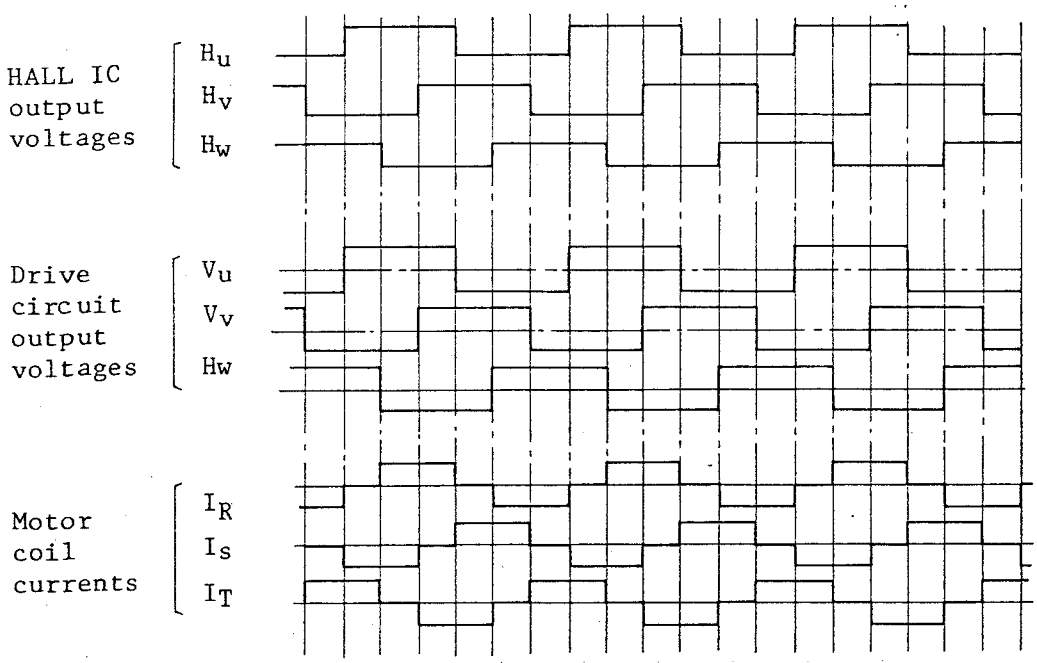


Fig. 2.30 Spindle Motor Drive Signal Time Chart

2.5.7 Overall FDD Operations (Timing Charts)

All operations mentioned in 2.5.1 through 2.5.6 are coordinated for overall FDD control. The timing charts of major operations are presented below for a better understanding of them.

(1) Initial seek (0 track seek)

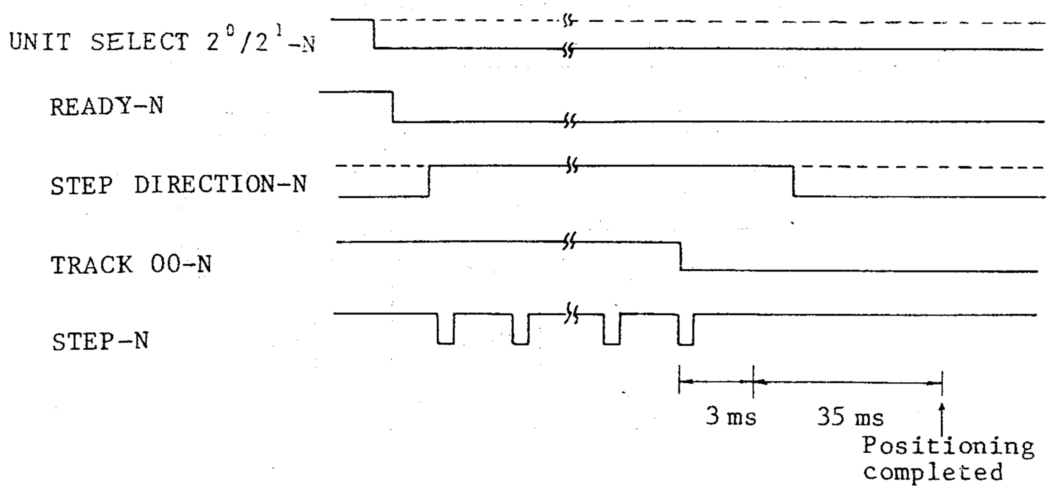
(2) 1 track positioning

(3) Multi-track positioning

(4) Write and read

(5) Write → Head engage off → Seek (in outer direction)

(1) Initial seek (0 track seek)

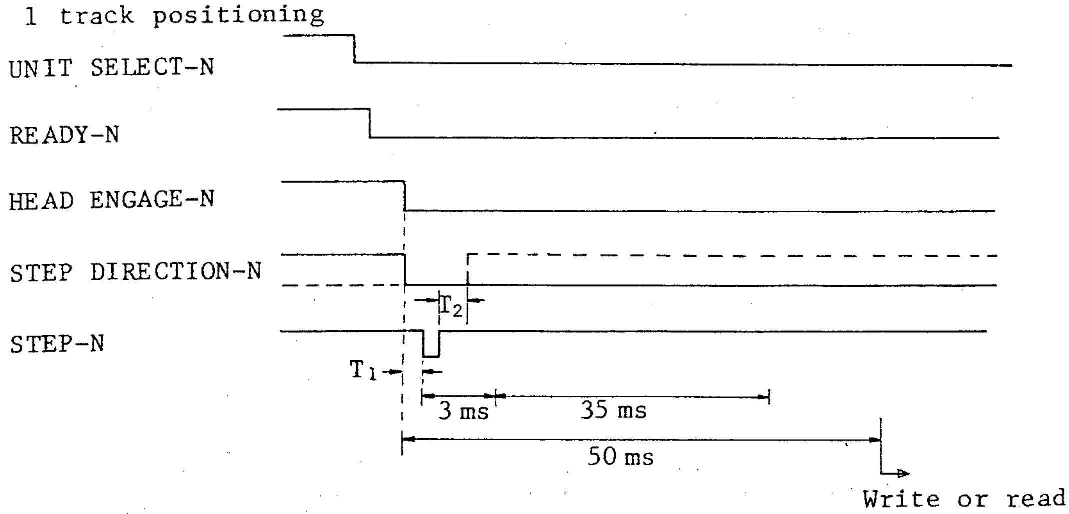


a) The STEP pulse is issued until the TRACK 00-N goes "low".

b) The STEP DIRECTION-N should be "high" while the STEP pulse is being issued.

Fig. 2.31 0 Track Seek Timing Chart

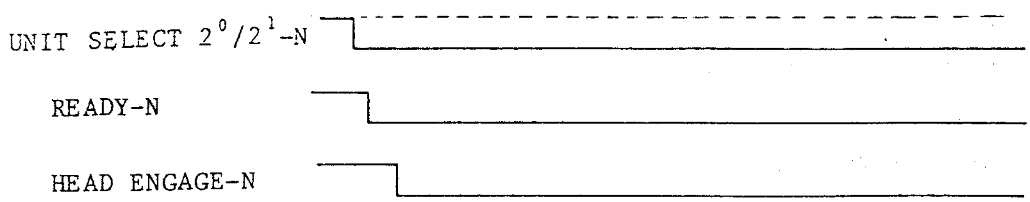
(2) 1 track positioning

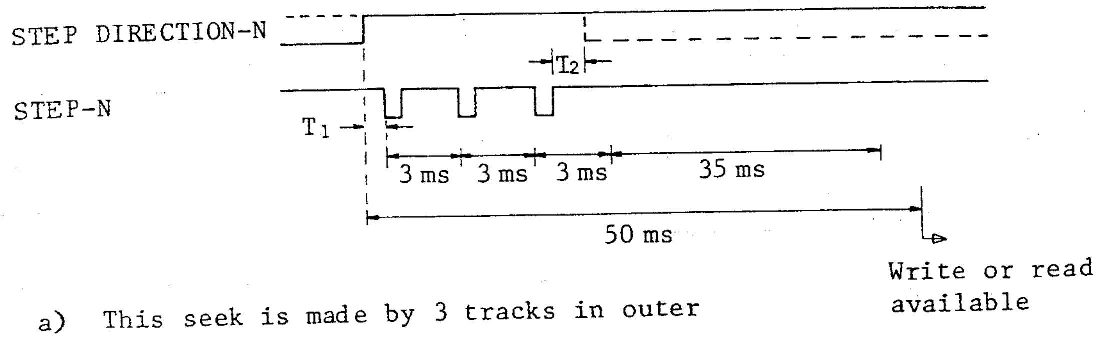


a) This seek is in the inner direction.
b) $T_1 \geq 50$ ns
c) $T_2 \geq 0$

Fig. 2.32 1 Track Positioning Timing Chart

(3) Multi-track positioning

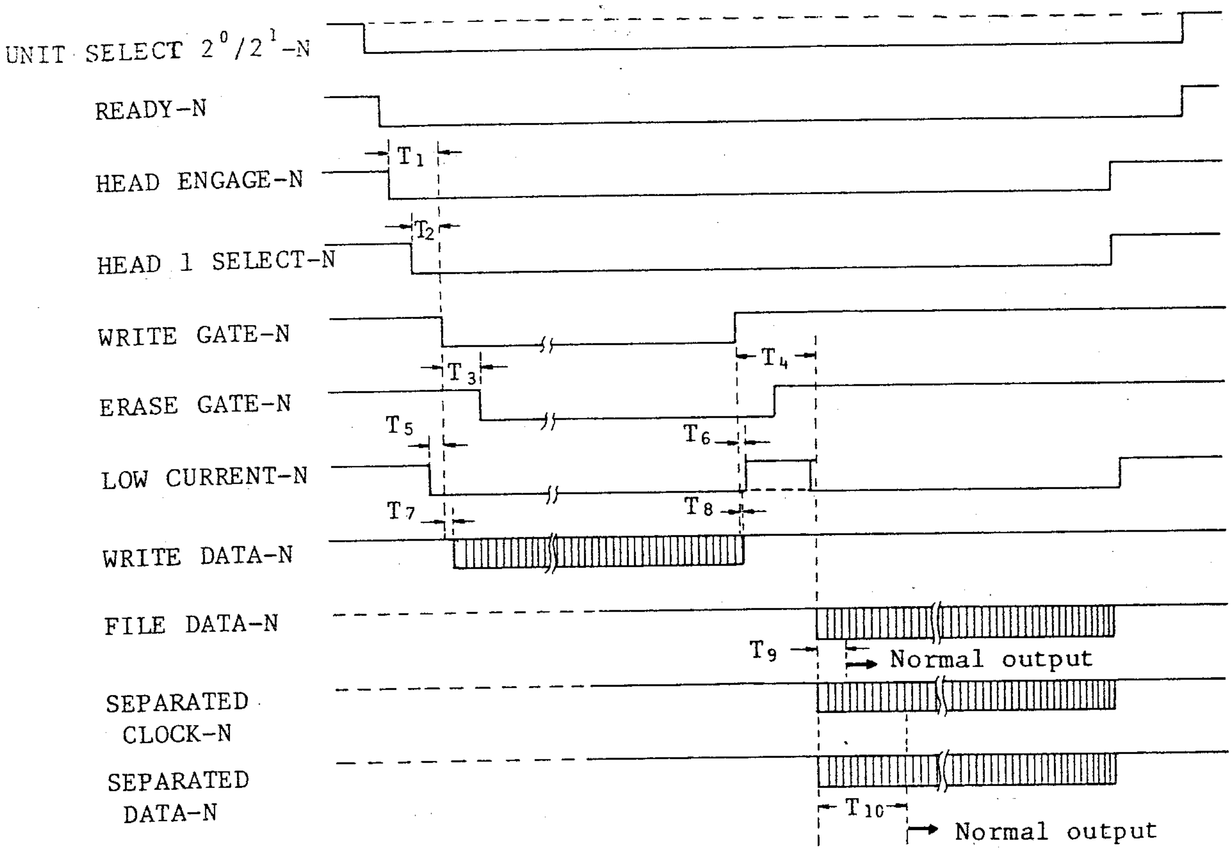




a) This seek is made by 3 tracks in outer direction.
b) $T_1 \geq 80$ ns
c) $T_2 \geq 0$

Fig. 2.33 Multi-track Positioning Timing Chart

(4) Write and read



a) $T_1 \geq 50$ ms
$T_2 \geq 50$ µs
$T_3 = 200$ µs TYP
$T_4 \geq 580$ µs
$T_5 \geq 0$
$T_6 \geq 0$
$0 \leq T_7 < 6$ µs
$0 \leq T_8 < 6$ µs
$T_9 = 50$ µs
$T_{10} = 242$ µs

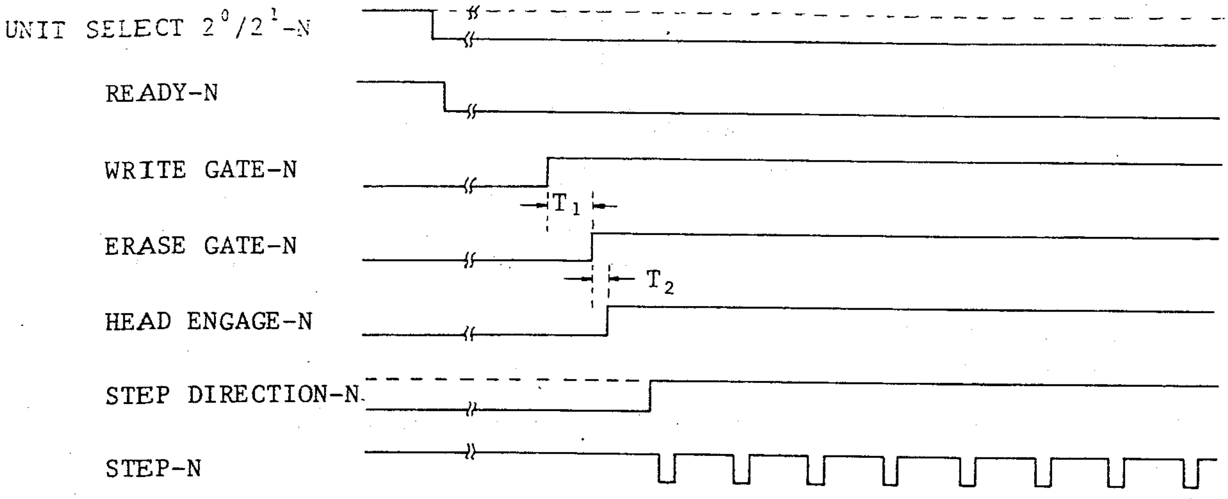
b) T_{10} is made a normal output after 16 bits of 0's are read from the VFO area.

c) The LOW CURRENT-N applies to tracks $44 \sim 76$.

d) The processing is on the head 1 side.

Fig. 2.34 Write and Read Timing Chart

(5) Data write → Head engage off → Seek (in outer direction)



a) $T_1 \geq 580\ \mu s$
$T_2 > 0$

Fig. 2.35 Head Engage Off/Seek Timing Chart

2.6 Interface

2.6.1 Connection of Floppy Disk Controller (FDC) to FDD

There are two types of FDC-to-FDD connection: daisy chain connection (Fig. 2.36) and star chain connection (Fig. 2.37).

In the daisy chain connection, one FDC can control up to 4 FDDs.
In the daisy chain connection, the FDD at the signal cable end needs to be equipped with a terminator, while all FDDs must each have a terminator in the star chain connection.

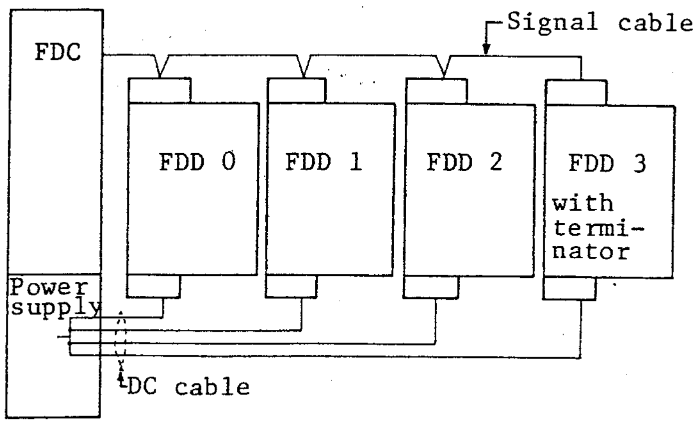


Fig. 2.36 Daisy Chain Connection (up to 4 FDDs Configured)

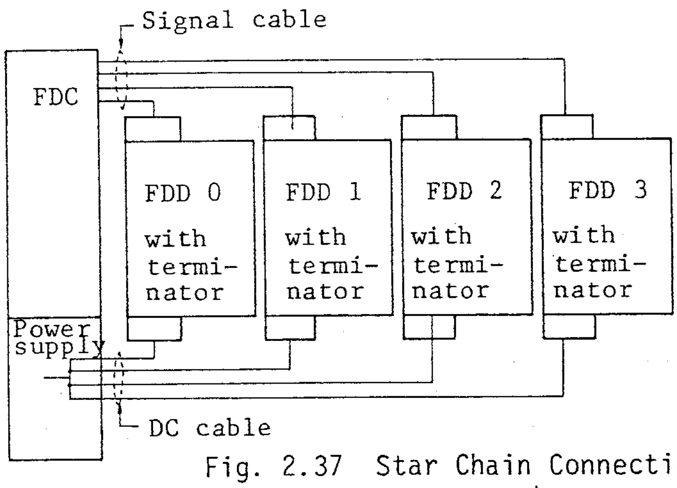
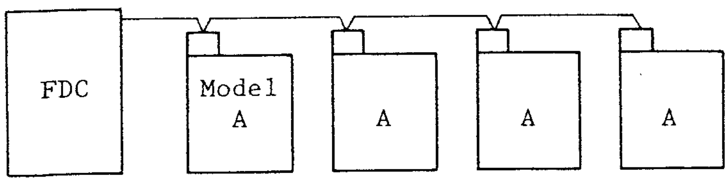


Fig. 2.37 Star Chain Connection

2.6.2 Device Configuration in Daisy Chain Connection

Three types of device configuration are available in the daisy chain connection, depending on the FDD type connected (model A or B). The configuration mode of each device is determined in each setup, by use of shorting-plug on the PWB. (For more information, refer to 3.2, "Setting of FDD Operation Mode".)

(1) Configuration with model A FDDs only

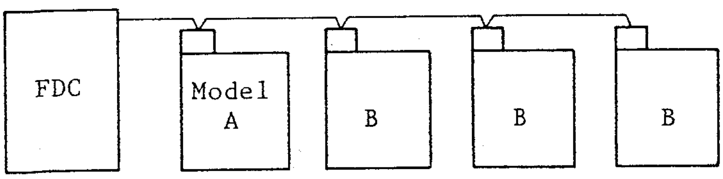


All devices:
Configuration mode 1

Fig. 2.38 Configuration with Model A FDDs Only

(2) Configuration with models A and B

In this case, include only one Model A anywhere in the configuration.

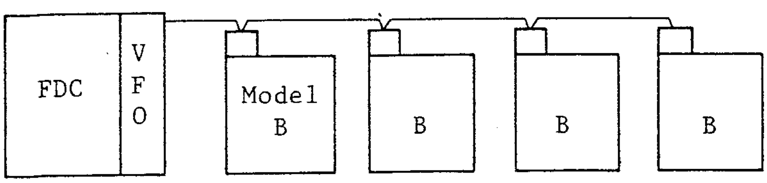


Model A:
Configuration mode 2
Model B:
Configuration mode 3

Fig. 2.39 Configuration with Models A and B

(3) Configuration with model B FDDs only

In this case, FDC shall have a built-in VFO.



All devices:
Configuration mode 4

Fig. 2.40 Configuration with Model B FDDs Only

2.6.3 Interface Signals

Table 2.13 shows the interface signals by type. See 2.5, "Logic Operations" for the operation of each signal, and 2.6.4, "Interface Signal Timing" for timing specifications.

Table 2.13 Interface Signal Types

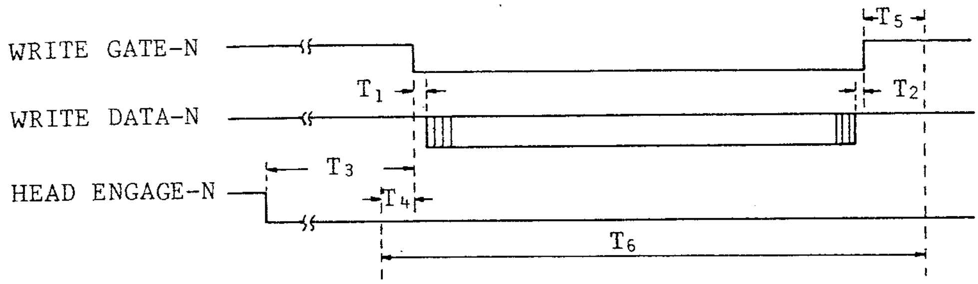
Type	Signal Name	Transfer Direction	Description
Select type	UNIT SELECT $2^0 2^1$-N	C → D	Provides FDD selection in hex code.
	READY 0,1,2,3-N	C ← D	Signals that the medium is correctly set and rotated in the FDD.
Status instruction/ display type	DISKETTE II SENSE-N	C ← D	Signals that a 2-sided medium is inserted.
	INDEX-N	C ← D	An index pulse generated once per revolution
	TRACK 00-N	C ← D	Signals that the magnetic head is positioned on the outermost track.
	FILE PROTECT-N	C ← D	Signals that a write-protected medium is set.
	FAULT-N	C ← D	Signals that a fault is detected in the FDD.
	FAULT RESET-N	C → D	Resets the fault in the FDD.
	DOOR LOCK SET-N	C → D	Causes the door to be locked.
	DOOR LOCK RESET-N	C → D	Releases the door lock.
Seek type	STEP-N	C → D	Moves the head, by 1 track per pulse.
	STEP DIRECTION-N	C → D	Instructs the direction in which to move the head.
Write type	WRITE GATE-N	C → D	Write instruction to tell the FDD to let current flow in the head.
	WRITE DATE-N	C → D	Write data modulated by the FM or MFM method
Read type	HEAD 1 SELECT-N	C → D	Causes head 1 to be selected for a two-sided medium.
	HEAD ENGAGE-N	C → D	Causes the head and medium to contact with each other.
	LOW CURRENT-N	C → D	Write mode: Write currents are switched. Read mode : Filter characteristics are switched.
	VFO SYNC-N	C → D	Causes the VFO circuit in the FDD to follow up on data.
	DATA AREA-N	C → D	Holds VFO synchronization while a data part is being read out.
	MFM GATE-N	C → D	Instructs the VFO to operate in the MFM mode.
	FILE DATA-N	C ← D	Data that was read via the head; before separation.
	SEPARATED DATA-N	C ← D	Data pulse in read data separated by the VFO
	SEPARATED CLOCK-N	C ← D	Data pulse in read data separated by the VFO
	VFO CLOCK-N	C ← D	Window signal used for reference during separation by the VFO
	2ND FILE DATA-N	D → D	Instructs FILE DATA-N signal transfer from model B to model A.

Note: C: FDC D: FDD

2.6.4 Interface Signal Timing

This section discusses the timing specifications for each signal. See the description of the operating principles involved for the operation and objective of each signal.

(1) WRITE GATE-N

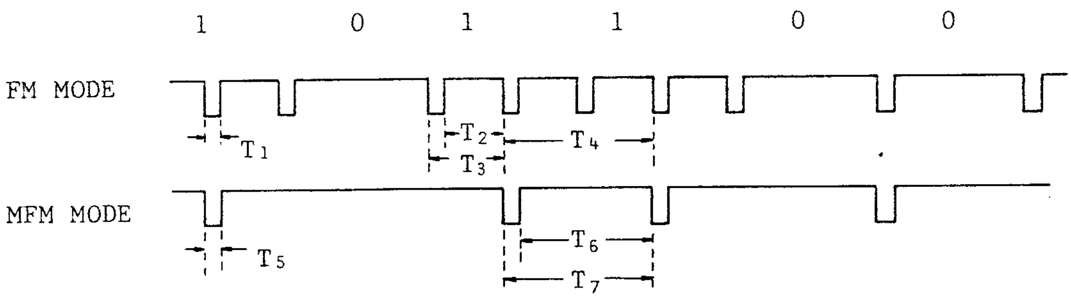


a) $0 \leq T_1 < 6\ \mu s$
$0 \leq T_2 < 6\ \mu s$
$T_3 \geq 50$ ms

$T_4 \geq 50\ \mu s$
$T_5 \geq 580\ \mu s$
T_6 : Head loading off / Head change / Read/seek } Inhibited area

Fig. 2.41 WRITE GATE Signal Timing

(2) WRITE DATA-N

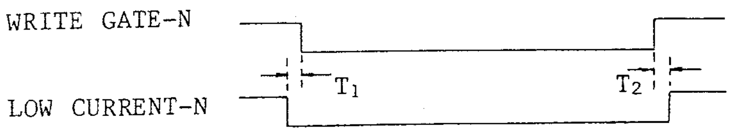


$T_1 \geq 180$ ns
$T_2 \geq 180$ ns
$T_3 = 1/2\ T_4$
$T_4 = 4.0\ \mu s \pm 0.1\%$

$T_5 \geq 180$ ns
$T_6 \geq 180$ ns
$T_7 = 2.0\ \mu s \pm 0.1\%$

Fig. 2.42 WRITE DATA-N Signal Timing

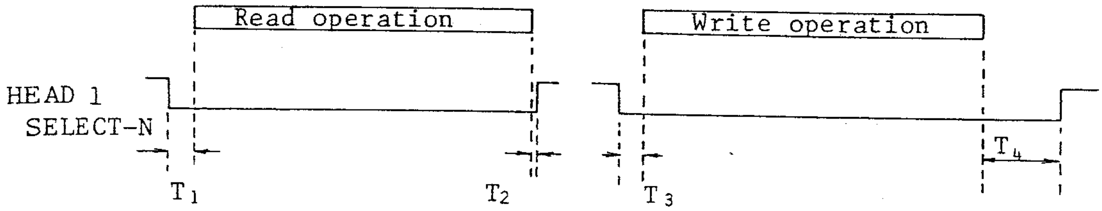
(3) LOW CURRENT-N



- $T_1 = T_2 \geq 0$
- READ/WRITE of 0∿43 TRACK: 'H'
  READ/WRITE of 44∿76 TRACK: 'L'

Fig. 2.43 LOW CURRENT Signal Timing

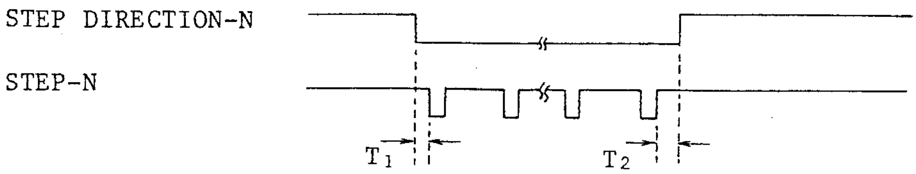
(4) HEAD 1 SELECT-N



- $T_1 \geq 50$ µs $T_3 \geq 50$ µs
  $T_2 \geq 0$ $T_4 \geq 580$ µs
- 'H' level = HEAD 0
  'L' level = HEAD 1

Fig. 2.44 HEAD 1 SELECT Signal Timing

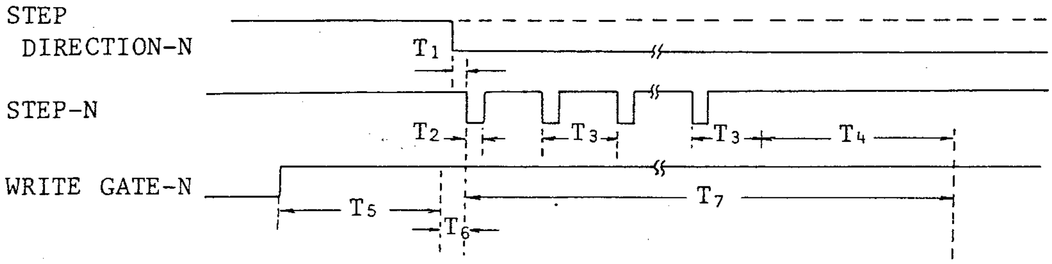
(5) STEP DIRECTION-N



- $T_1 \geq 50$ ns
  $T_2 \geq 0$
- 'H' level = in outer direction
  'L' level = in inner direction

Fig. 2.45 STEP DIRECTION-N Signal Timing

(6) STEP-N

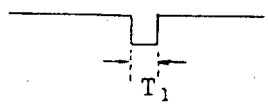


- $T_1 \geq 50$ ns
  2 ms $> T_2 \geq 1$ µs
  $T_3 \geq 3$ ms
  $T_4 \geq 35$ ms (settling time)
- $T_5 \geq 580$ µs
  $T_6 \geq 0$
  T_7 : Read/write inhibit area
- Step pulse count = | Current cylinders' No. - New Cylinders' No. |

Fig. 2.46 STEP-N Signal Timing

(7) FAULT RESET-N

FAULT RESET-N

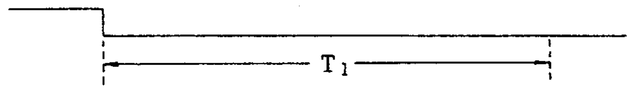


$T_1 > 200$ ns

Fig. 2.47 FAULT RESET-N Signal Timing

(8) HEAD ENGAGE-N

HEAD ENGAGE-N

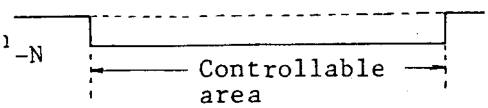


- $T_1 \geq 50$ ms read/write inhibit area.
- 'Low' level must not be reached if the FDD is not in ready state.

Fig. 2.48 HEAD ENGAGE-N Signal Timing

(9) UNIT SELECT $2^0/2^1$-N

UNIT SELECT $2^0/2^1$-N



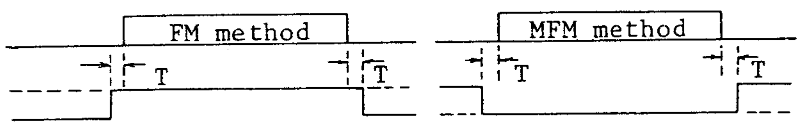
Device address				
	0	1	2	3
2^0-N	H	L	H	L
2^1-N	H	H	L	L

Fig. 2.49 UNIT SELECT Signal Timing

(10) MFM GATE-N

Data

MFM GATE-N



- $T \geq 0$

Fig. 2.50 MFM GATE-N Signal Timing

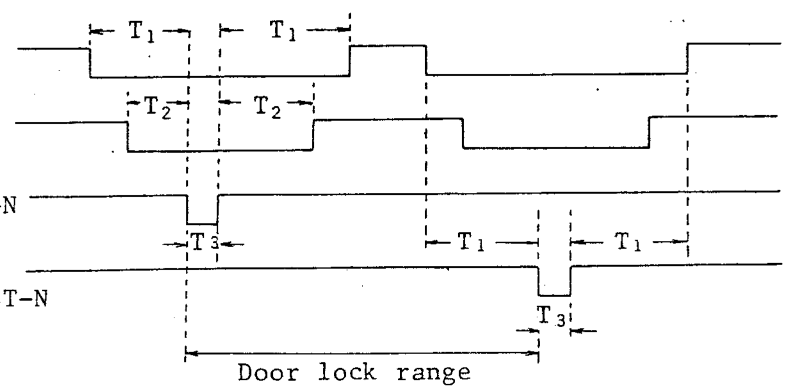
(11) DOOR LOCK SET-N
DOOR LOCK RESET-N

UNIT SELECT-N

READY-N

DOOR LOCK SET-N

DOOR LOCK RESET-N



- $T_1 \geq 100$ ms $T_3 \geq 1$ µs
  $T_2 \geq 100$ ms
- This signal must not be issued during a read/write operation.
- The door is locked while the head is engaged, independent of this signal.
- This signal can be nullified by switching a shorting-plug on the PWB.

Fig. 2.51 DOOR LOCK SET/RESET Signal Timing

(12) VFO SYNC-N
DATA AREA-N

See Figs. 2.52 and 2.53.

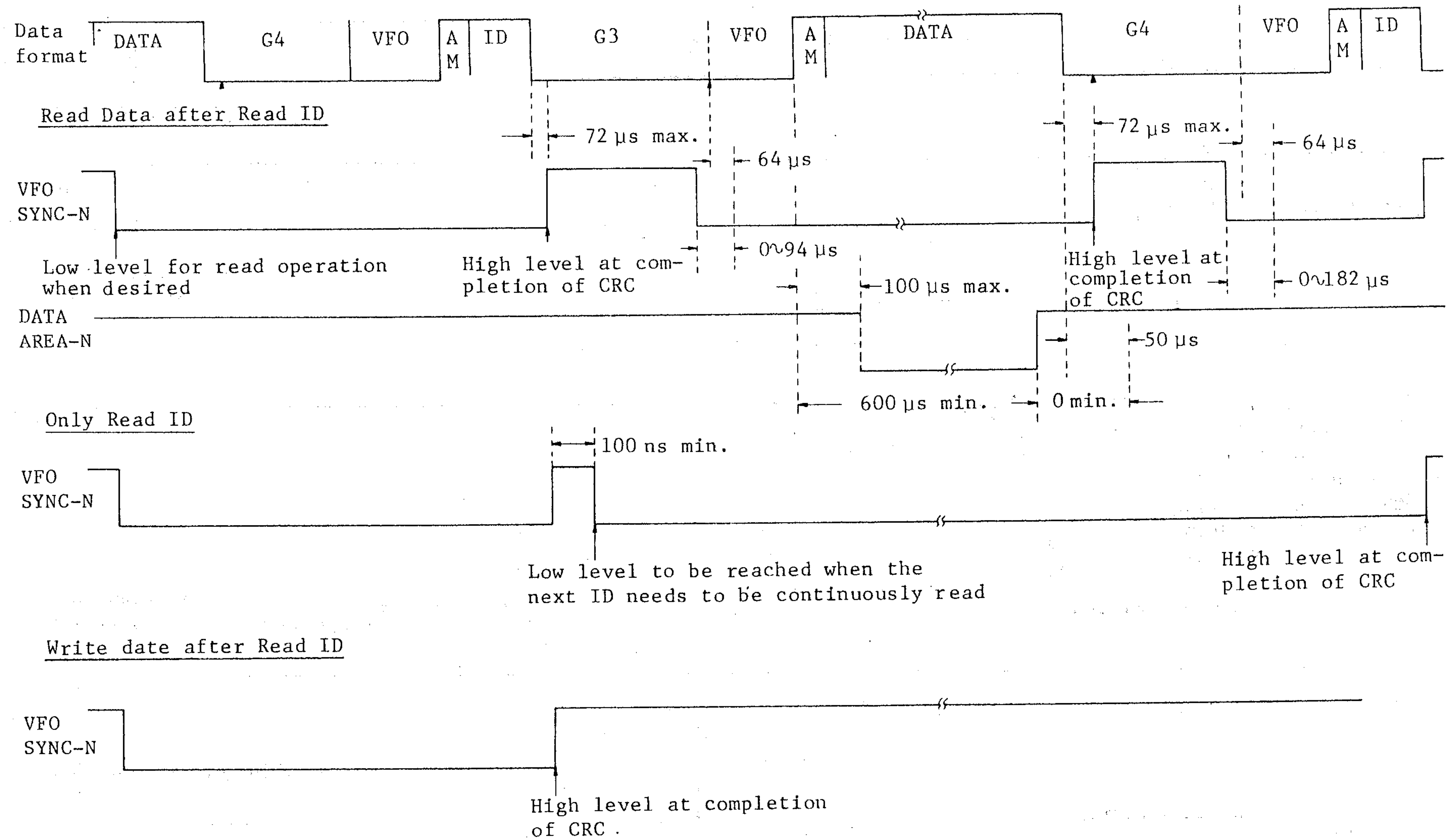


Fig. 2.52 Timing Chart for VFO SYNC-N and DATA AREA-N Signals

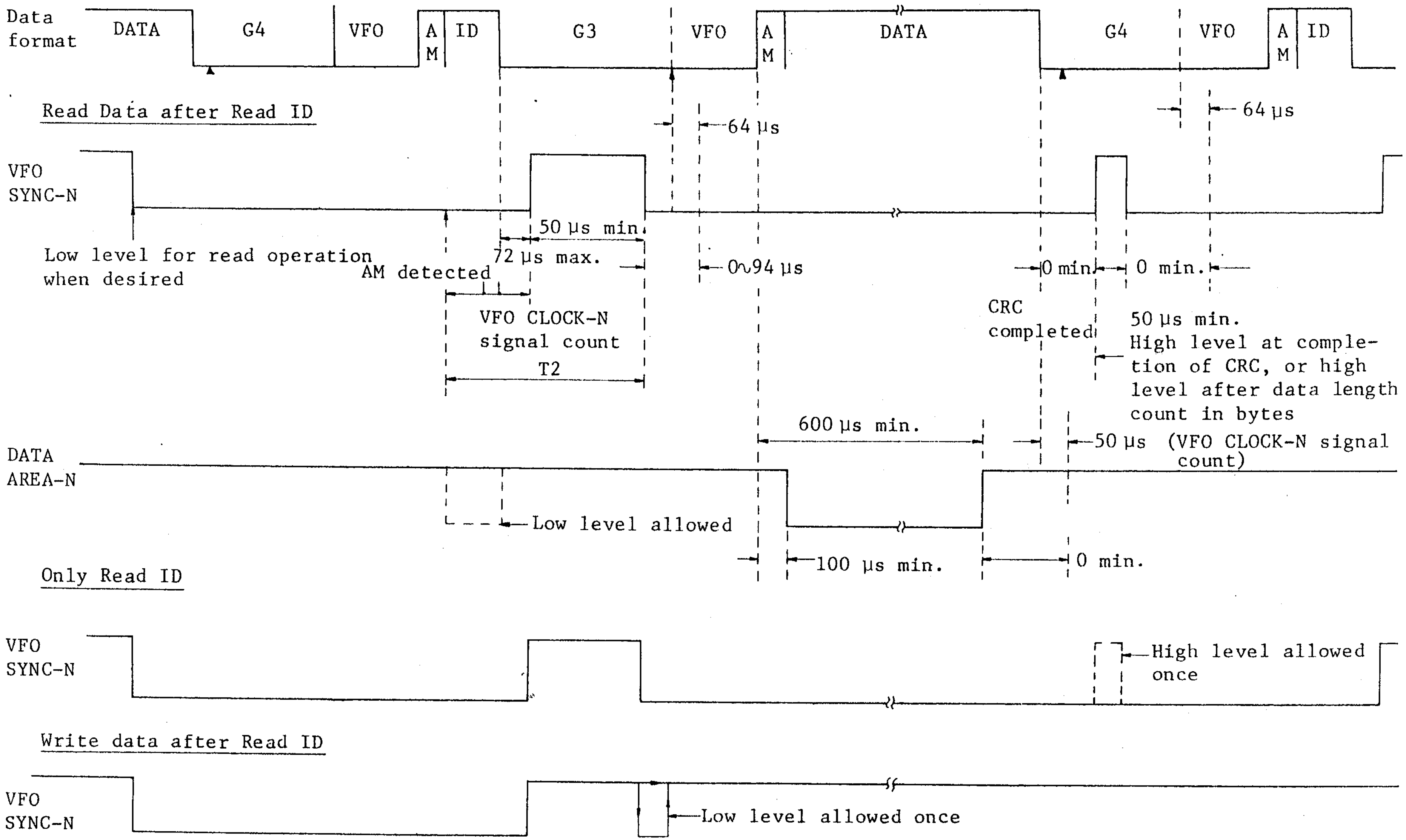
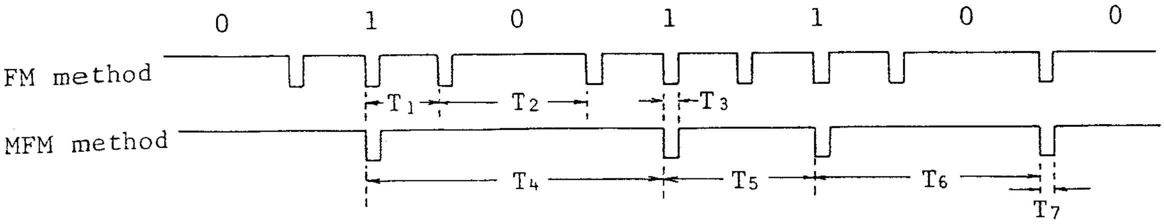


Fig. 2.53 Timing Chart for VFO SYNC-N and DATA AREA-N Signals (VFO CLOCK-N Signal Count System)

(13) FILE DATA-N



- T_1 = 2 µs (TYP)
  T_2 = 4 µs (TYP)
  T_3 = 220 ns (TYP)

  T_4 = 4 µs (TYP)
  T_5 = 2 µs (TYP)
  T_6 = 3 µs (TYP)
  T_7 = 220 ns (TYP)

- A SEPARATED DATA signal is in effect when the VFO is used.
- This signal is unpredictable when nothing is written, the head is not loaded on, or a seek operation is performed.

Fig. 2.54 FILE DATA-N Signal Timing

(14) INDEX-N

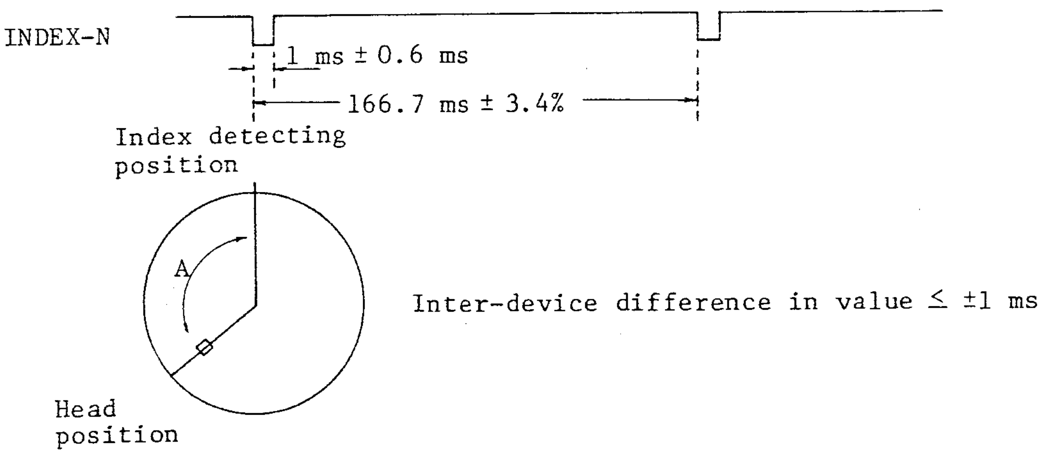


Fig. 2.55 INDEX Signal Timing

(15) SEPARATED DATA-N
SEPARATED CLOCK-N
VFO CLOCK-N

Refer to Figs. 2.56 and 2.57

- The VFO CLOCK can be set for type A or B by changing shorting-plug locations on the PCB.
- The period of time for the VFO to start is 192 µs from the beginning of the VFO area. It is necessary for data to be read in after an elapsed time of 192 µs.

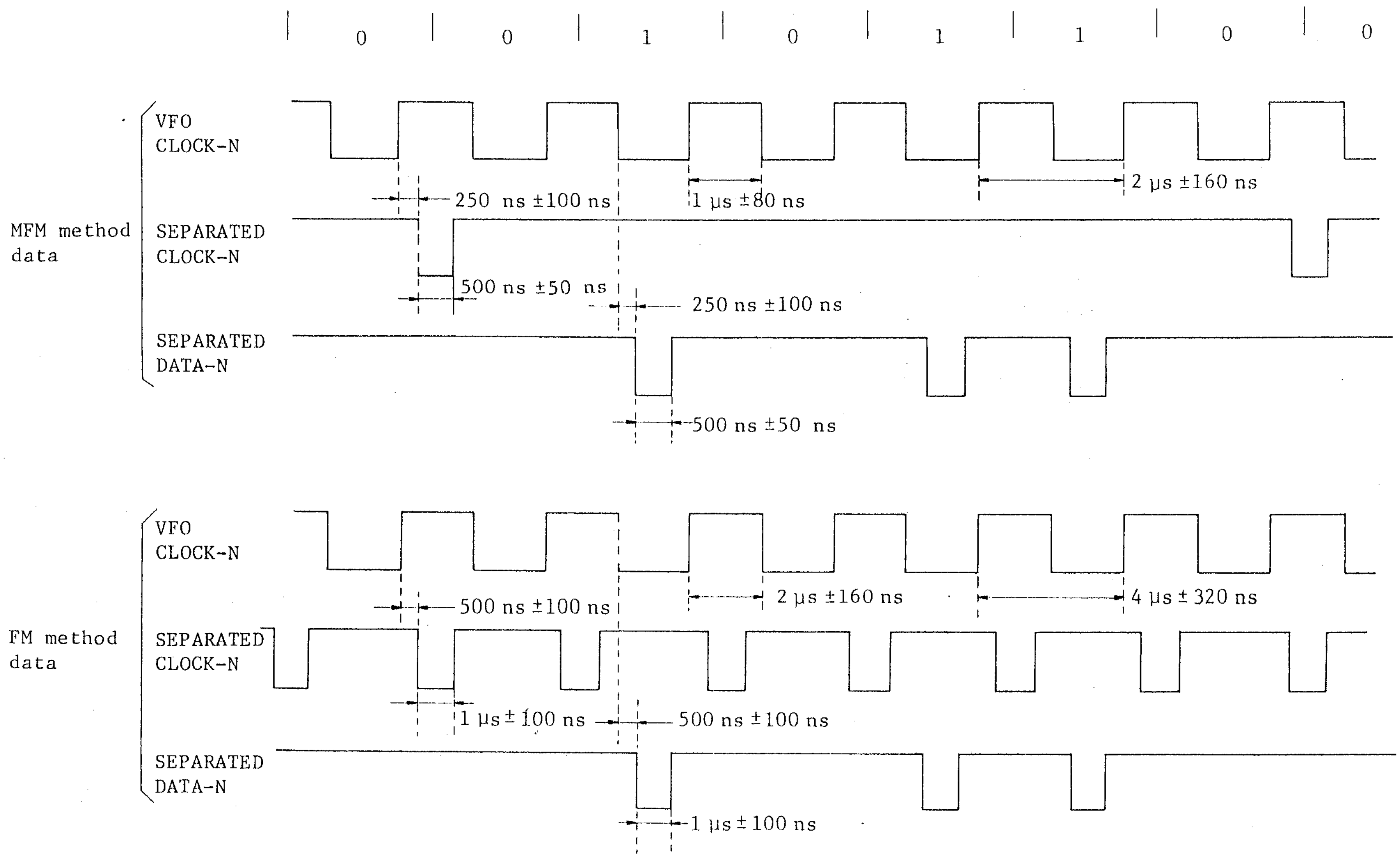


Fig. 2.56 Data Transfer Timing Based on VFO CLOCK A System

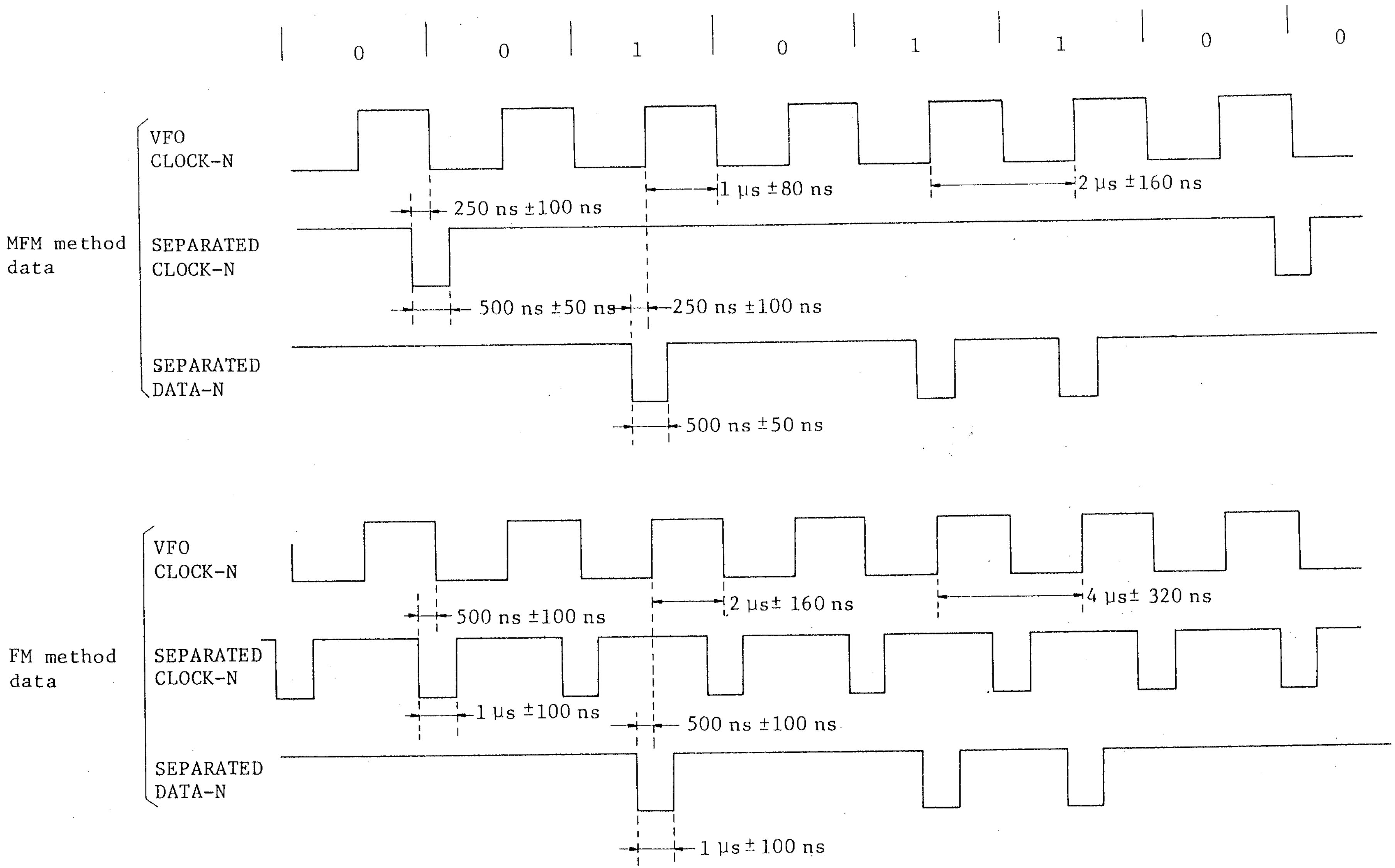
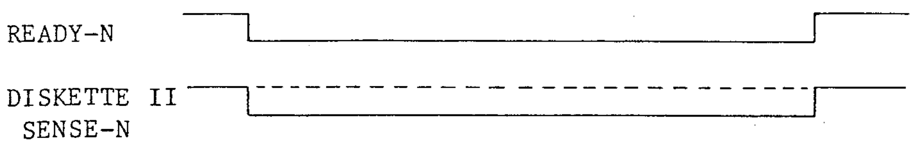


Fig. 2.57 Data Transfer Timing Based on VFO CLOCK B System

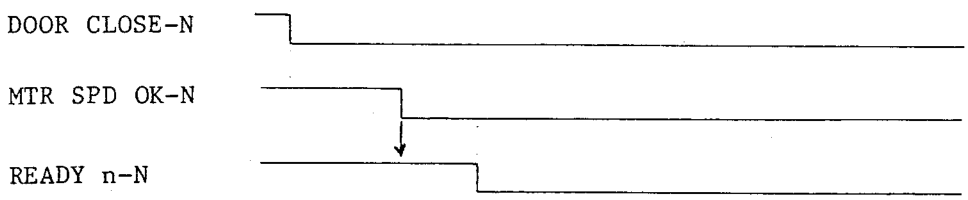
(16) DISKETTE II SENSE-N



- Two-sided floppy disk : 'L' level
- Single-sided floppy disk: 'H' level

Fig. 2.58 DISKETTE II SENSE Signal Timing

(17) READY 0-N (Unit 0)
READY 1-N (Unit 1)
READY 2-N (Unit 2)
READY 3-N (Unit 3)



- MTR SPD OK-N: A signal from the spindle motor, at 'Low' level at a fixed rotational speed or lower.
- READY n : A signal that is output after 2 indexes are detected following the MTR SPD OK

Fig. 2.59 READY Signal Output Timing

(18) FAULT-N

The FAULT-N signal 'Low' when:

(a) The WRITE GATE comes in while the device is not ready,

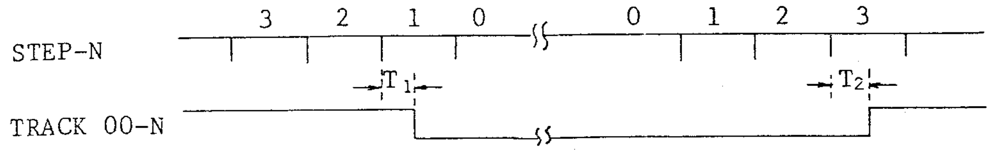
(b) The WRITE GATE comes in while the head is not loaded on,

(c) The HEAD 1 SELECT comes in while a single-sided floppy disk is mounted, or

(d) The WRITE DATA does not come in spite of the WRITE GATE has come already.

- Data write operation is inhibited.
- The signal is reset by the FAULT RESET-N or by another application of power.

(19) TRACK 00-N



- $T_1 \pm 0.3$ ms $= T_2$
- $T_1 \geq 0$
- $T_2 \geq 0$

Fig. 2.60 Track 00-N Signal Timing

(20) FILE PROTECT-N

- With protect notch : 'Low' level
- Without protect notch: 'High' level

(21) 2ND FILE DATA-N

- This signal is used only in a daisy chain connection.
- The specifications are the same as those of the FILE DATA-N of (13) above.

3. HANDLING

3.1 Handling Procedures

3.1.1 Floppy Disk Not in Use

(1) Keep the door handle closed. Dust and foreign matters will enter the drive if the door is left open.

3.1.2 Insertion of Floppy Disk

(1) Before opening the door, check that the LED for READY indication on the top cover is not lit.

(2) Open the door, and insert the floppy disk until it hits a stopper. (The disk is automatically latched; it is kept from popping out by an ejector spring.)

(3) Do not press the floppy disk once the stopper is reached.

(4) Take care to orientate the floppy disk label correctly. (The manufacturer's ID label should be on the door handle side.)

(5) Do not leave the floppy disk inserted halfway. (The spindle may damage the disk jacket.)

(6) Insert the disk while the spindle is rotating.

3.1.3 Opening/Closing of Door; Floppy Disk in Use

(1) Hold the door center, and close the door gently. At this time, check that the door lock is released.

(2) When closed, the door is latched and secured.

(3) While the floppy disk is in use, do not apply impact (like hitting the top cover) on the drive.

3.1.4 Removal of Floppy Disk

(1) Check that the LED is not flashing.

(2) Press the button, and the door will open and part of the floppy disk will pop out of the FDD by an auto-ejector mechanism. Pick up the disk and put it in its envelope for storage.

(3) Where the FDD is not used for the time being, close the door as per step (1) in 2.1.

3.1.5 Handling of Floppy Disk

(1) Use recommended floppy disks.

(2) Put the index label and write enable label at correct locations. Before insertion to the FDD, check to see if the labels are securely in place.

(3) Do not use floppy disks which are substantially deformed, bent, or broken.

(4) Do not pierce the medium jacket with a pin, put a clip on it, or scribble on it in pencil or ball-point pen.

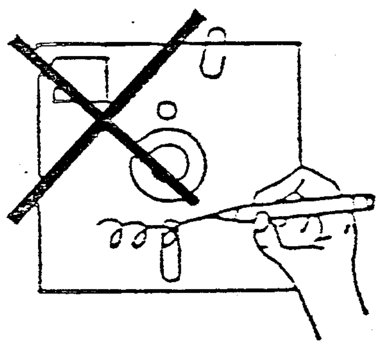


Fig. 3.1

(5) Store the recording media in a dust-free place.

A dedicated storage case, if provided, should always be used for storage, with the media arranged horizontally or vertically.

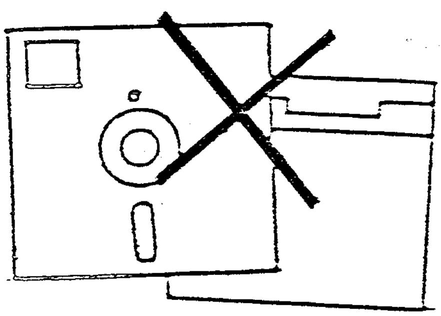


Fig. 3.2

(6)

Do not touch, or wipe with solvent, the oxide-coated medium surfaces.

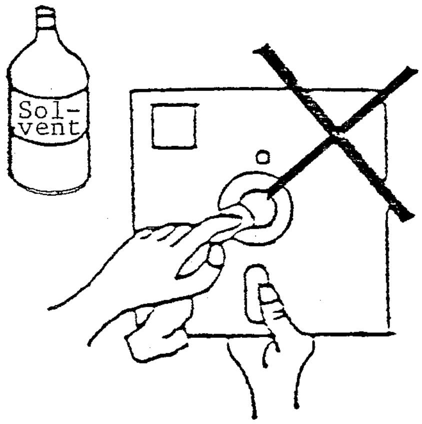


Fig. 3.3

(7)

Keep the recording media away from magnetic fields.

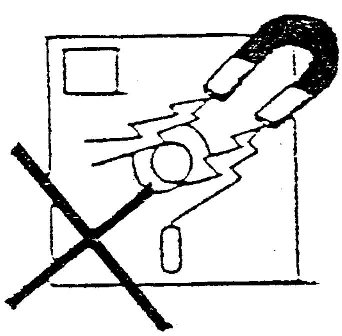


Fig. 3.4

(8)

Do not expose the recording media to heat or direct incident sunlight.

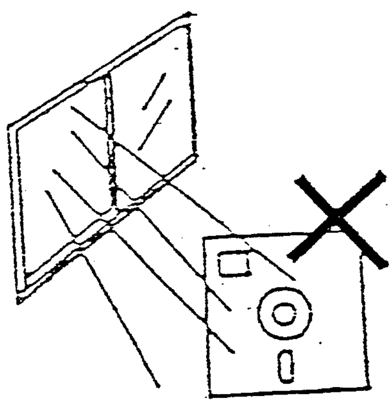


Fig. 3.5

(9) The floppy disk should be under the following conditions in at least 5 minutes before use:

Temperature	:	10 ∿ 43°C
Relative humidity	:	20 ∿ 80% RH
Maximum wet bulb temperature	:	20°C (without dew condensation)

(10) Sticking the write permission label

The floppy disk jacket is provided with an inhibit notch at the position shown in Fig. 3.6.

The disk with the notch, when inserted into the FDD, is automatically protected from writing.

To write data onto the disk, stick a write permission label over the inhibit notch beforehand, in the following steps:

(a) Wipe a small area around the notch using a Freon-soaked clean rag.

(b) Peel a write permission label off its mount.

(c) Put the label carefully over the notch.

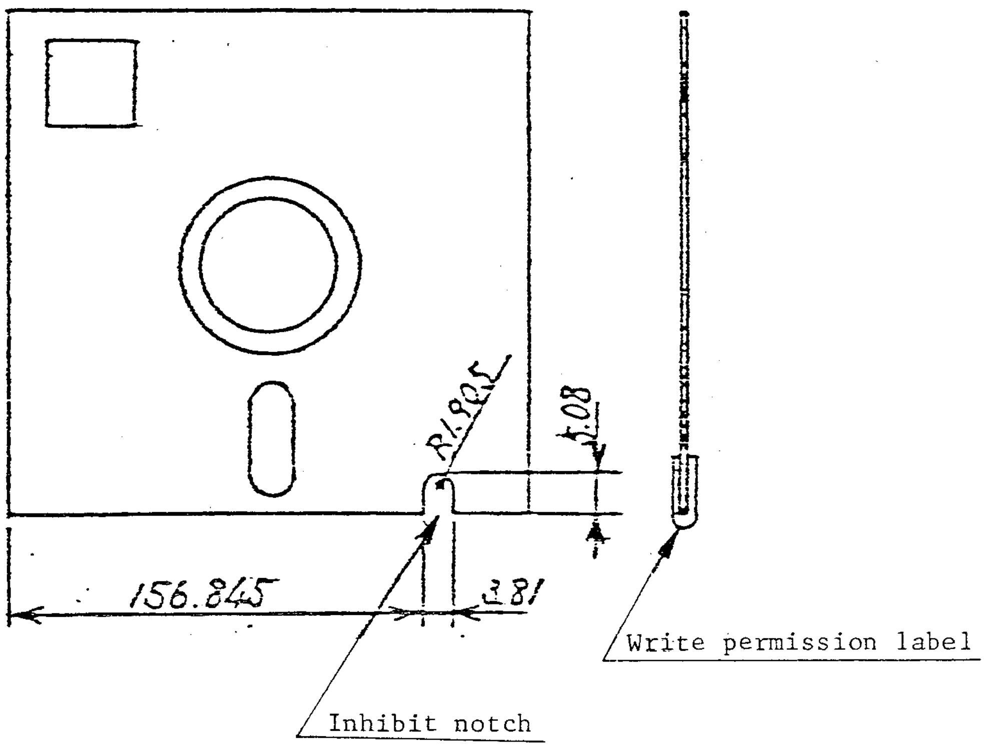


Fig. 3.6 Inhibit Notch and Write Enable Label

3.1.6 Relocation

(1) When relocating the FDD, hold its base.

Lifting the top cover may cause the body to fall off. (The top cover is detectable. Check that the cover is securely latched on the body.)

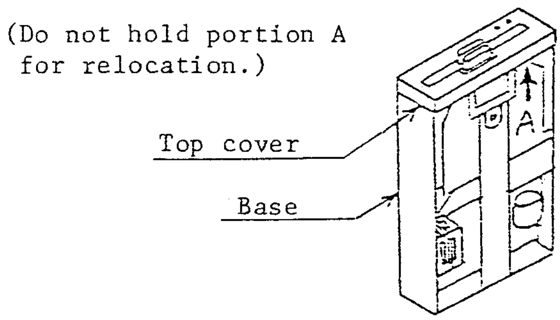
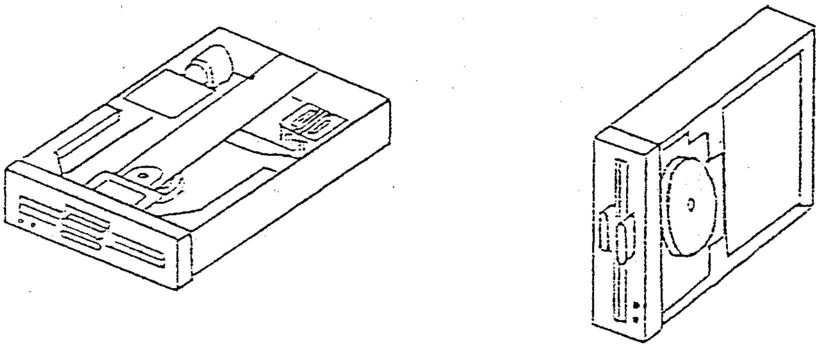


Fig. 3.7

(2) Do not turn any unspecified screws. Some of them are pre-adjusted in the factory.

(3) Position the FDD as shown below.



(Upside down position permitted)

Fig. 3.8 How to Place FDD

3.1.7 Packaging, Transit and Storage

After cleaning, pack the FDD by following the steps given below.

(1) Put the FDD in a vinyl bag.

(2) Use for external packaging the corrugated box and cushioning material employed in delivery from the factory, or devise a cushioning structure that protects the FDD from direct impact.

(3) Indicate the top and bottom clearly on the external packaging. Write instructions outside requesting careful handling and no turning-over.

(4) In packaging, unpackaging and transit, use care to keep the PCB surface parts from undue strain.

(5) Upon packaging, insert between 2 heads a protection sheet used in delivery from the factory. This measure is to protect the head surfaces.

(6) Pack the FDD so that no impact greater than 5G will be applied to the device in transit.

(7) For storage, devise moisture-resistant packaging.

(8) Do not turn any unspecified screws.

Some of them are pre-adjusted in the factory.

3.2 Setting of FDD Operation Mode

3.2.1 Operation Mode Change by Shorting-Plugs

Installing shorting-plugs at specified locations sets the operation mode according to the user's configuration. Figure 3.9 shows a typical operation mode setting.

(1) Unit numbers

Referring to the following table, set shorting-plugs to the respective unit numbers.

Table 3.1 Unit Number Setting

Unit No.	JP1
0	Shorted across 1 to 3
1	Shorted across 2 to 4
2	Shorted across 3 to 5
3	Shorted across 4 to 6

(2) Device configuration mode in daisy chain connection

Install shorting-plugs according to the following table for setting to the required configuration mode:

Table 3.2 Configuration Mode Setting

<table>
<tr><th>Configuration Mode</th><th colspan="2">Configured Drives</th><th>JP1</th></tr>
<tr><td>1</td><td colspan="2">Model A drives only</td><td>Shorted across 9 to 10, across 11 to 13, and across 14 to 16</td></tr>
<tr><td>2</td><td rowspan="2">Model A/B drive</td><td>Model A drive</td><td>Shorted across 10 to 12 and across 11 to 13</td></tr>
<tr><td>3</td><td>Model B drive</td><td>Shorted across 15 to 16</td></tr>
<tr><td>4</td><td colspan="2">Model B drives only</td><td>Shorted across 9 to 11 and across 14 to 16</td></tr>
</table>

(3) VFO clock phase system (applicable to model A)

Set the required phase system according to the following table:

Table 3.3 Setting of VFO Clock Phase System

Phase System	JP2
A	Open across 5 to 6
B	Shorted across 5 to 6

(4) Changeover from model A to model B

A model A FDD can be used as a model B FDD by changing shorting-plug locations according to the following table:

Table 3.4 Changeover from Model A to Model B

Changeover Contents	The JP1 state for configuration mode 1 or 2 is changed to the following state:
To model B in configuration mode 3	Shorted across 15 to 16
To model B in configuration mode 4	Shorted across 9 to 11 and across 14 to 16

(5) Door lock control mode

Set the required door lock control mode by installing a shorting-plug according to the following table:

Table 3.5 Setting of Door Lock Control Mode

DOOR LOCK SET/RESET-N Signal	JP2
Set	Shorted across 1 to 2
Reset	Shorted across 1 to 3

When the HEAD ENGAGE-N signal is input, the door is locked independent of the above setting.

(6) Terminator

The terminator consists of a DIP type resistor module and jumper connector JP1 (7∿8). Perform setting as follows:

Table 3.6 Terminator Setting

Terminator	DIP Type Resistor Module	JP1
Provided	Installed in IC socket	Shorted across 7 to 8
Not provided	Not installed in IC socket	Open across 7 to 8

The following type of shorting-plug is recommended:

8261 series ELBIT type II (available from ELCO)
No. 00-8261-0242-00-870

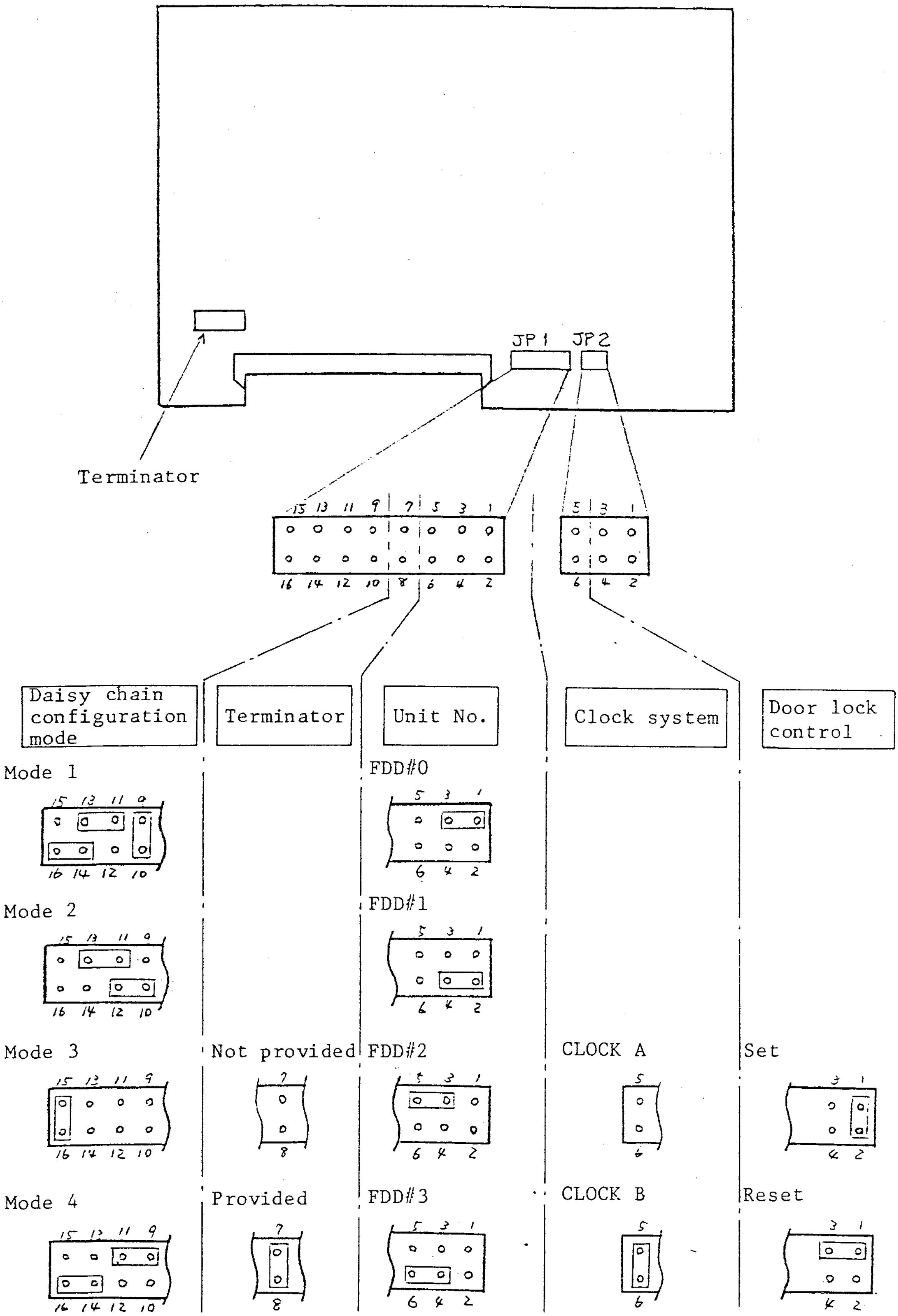


Fig. 3.9 Typical Setting of Operation Mode

3.2.2 Shorting-plug Presetting Position upon Shipment from Factory

Shorting-plugs are installed as shown below when the FDD is shipped from the factory.

Table 3.7 Shorting-plug Presetting Position upon Delivery

No.	Item	Setting Contents	Shorting-plug
1	Unit No.	0	JP1; shorted across 1 to 3
2	Configuration mode in daisy chain connection	Model A 1	JP1; shorted across 9 to 10 and across 11 to 13, across 14 to 16
		Model B 4	JP1; shorted across 9 to 11 and across 14 to 16
3	VFO clock phase system (applicable to model A)	System A	JP2; open across 5 to 6
4	DOOR LOCK SET/ RESET-N signal	No effect	JP2; shorted across 1 to 3
5	Terminator	Provided	JP1; shorted across 7 to 8, with DIP type resistor module installed

Notice that:

(a) JP3 must be always open for all pins, and
(b) Pin 4 of JP2 is for maintenance and is normally open.

4. MAINTENANCE

4.1 Maintenance Items

This FDD has no parts to be replaced or no items to be adjusted on a periodical basis. Table 4.1 shows the parts and items to be replaced or adjusted in case of failure.

Table 4.1 Maintenance Items

No.	Item	Reference		Remarks
		Para.No.	Page	
1	Common work 1: Top cover	4.2.1	55	
2	Common work 2: Plate opening/closing	4.2.2	55	
3	Common work 3: Wire handling and wire routing	4.2.3	56	
4	PWB Assembly (FCC 14)	4.2.4	58	
5	Motor (DD spindle)	4.2.5	58	
6	Head load solenoid	4.2.6	59	
7	Bail assembly	4.2.7	60	
8	0 sensor assembly	4.2.8	61	
9	Protect sensor assembly	4.2.9	62	
10	Index sensor assembly	4.2.10	62	
11	Index LED assembly	4.2.11	63	
12	Microswitch assembly	4.2.12	64	
13	Center cone assembly	4.2.13	64	
14	Plate assembly	4.2.14	65	
15	Indicator assembly	4.2.15	66	
16	Door lock assembly	4.2.16	67	
17	Door button	4.2.17	67	
18	FPH-680T assembly	4.2.18	68	
19	Step motor	4.2.19	70	
20	Head position (tracking) adjustment	4.3.1	71	
21	0 track sensor position adjustment	4.3.2	74	
22	Bail stopper elevation adjustment	4.3.3	75	

2 Parts Replacement Procedures

4.2.1 Common Work 1: Top Cover

(1) Tools and measuring instruments to be used:

None

(2) Disassembling

Disengage the cover off the guide at the inset in the order 1∿4 shown in Fig. 4.1. The removal is made easier by applying force in the arrowed directions.

The cover, being of molding, should not be subjected to undue strain.

(3) Assembling

Check that the indicator lamps align with guide holes on the cover. Push the cover down to fit.

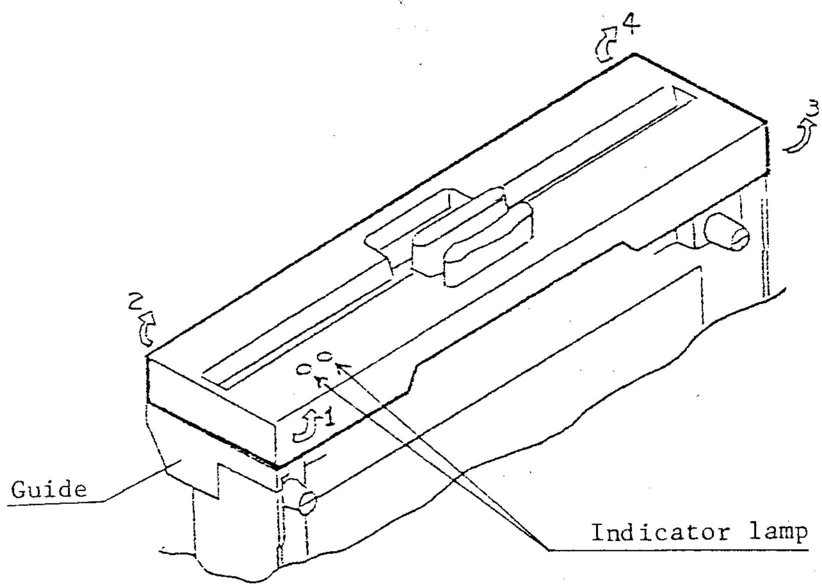


Fig. 4.1 Top Cover

4.2.2 Common Work 2: Plate Opening/Closing

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver

(2) Disassembling

(a) Remove the top cover as per the procedure described in 4.2.1.

(b) Remove shutter get screws (M3 × 2), and dismount the shutter by pushing it to the left (Fig. 4.2).

(c) While keeping the head load bail steady by hand, remove the spring (bail) set screw (M3 tapping × 1) and take out the spring.

(d) Push the door button to open the plate.

(3) Assembling

(a) Engage the plate fulcrum spring through spring guide holes and close the plate.

(b) While keeping the head load bail steady by hand, mount the spring (bail). Fix the spring with a tapping screw, aligning the spring hole with a dowel.

Do not overtighten the teapping screw.

(c) Secure the shutter, aligning the dowel with hole.

(d) Mount the top cover.

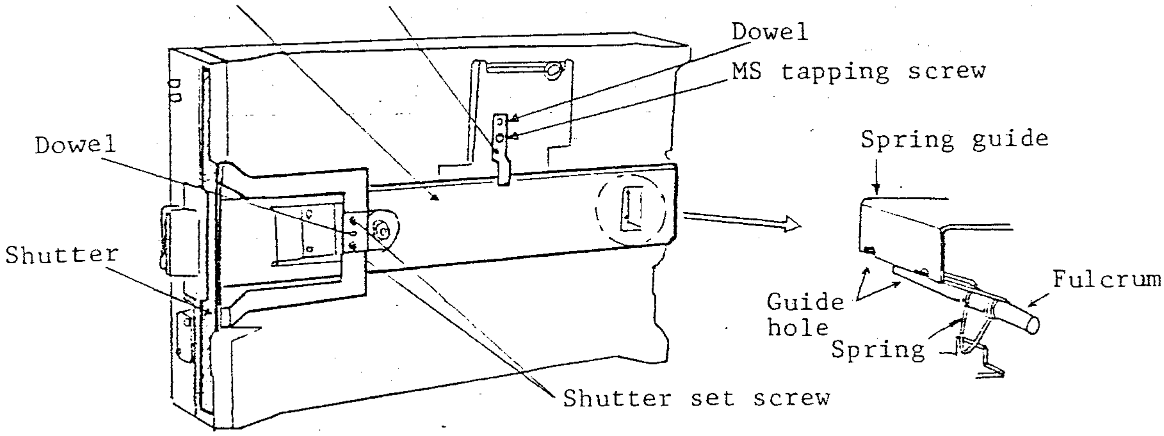


Fig. 4.2 How to Open/Close Plate

4.2.3 Common Work 3: Wire Handling and Wire Routing

(1) Tools and measuring instruments to be used:

- Small flat screwdriver or

(2) Diassembling

(a) As shown in Fig. 4.3, the J3 connector is secured to the housing by a contact pin click.

(b) When disengaging a contact pin, push in the small screwdriver to release the locked click.

(3) Assembling

(a) Insert the contact pin, having its click facing outward.

(4) Caution

(a) If a wrong pin is inserted, extract the pin, pull up its click, and insert the pin into the correct location. The contact pin is designed to withstand up to three relocations.

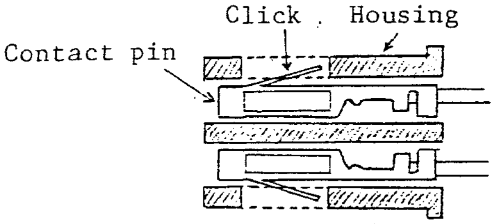


Fig. 4.3 J3 Connector Structure

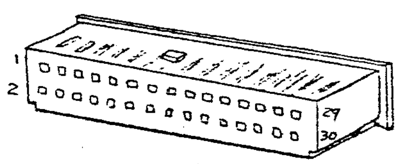


Fig. 4.4 J3 Connector Pin Arrangement

Table 4.2 J3 Connector Wiring Arrangement

Pin No.	Signal Name	Pin No.	Signal Name
1	FILE PROTECT (+5V)	2	FILE PROTECT LED GRD
3	FILE PROTECT (sensor output)	4	TRACK 00 (+5V)
5	TRACK 00 (sensor output)	6	TRACK 00 LED GRD
7	INDEX LED (+5V)	8	INDEX LED GRD
9	INDEX 1 (sensor output)	10	INDEX 1/2 GRD
11	INDEX 2 (sensor output)	12	DISPLAY LED 1
13	DISPLAY LED 2	14	DISPLAY LED GRD
15	DOOR SWITCH OPEN	16	DOOR SWITCH GRD
17	DOOR SWITCH CLOSE	18	STEP MTR + (black)
19	STEP 4 (red)	20	STEP 1 (blue)
21	STEP 2 (yellow)	22	STEP 3 (white)
23	HEAD LOAD SOL -	24	DOOR LOCK SOL +
25	HEAD LOAD SOL +	26	DOOR LOCK SOL -
27		28	
29		30	

(5) Wire routing

After replacement, perform wiring with each clamper used for fixing on the base according to Fig. 4.5.

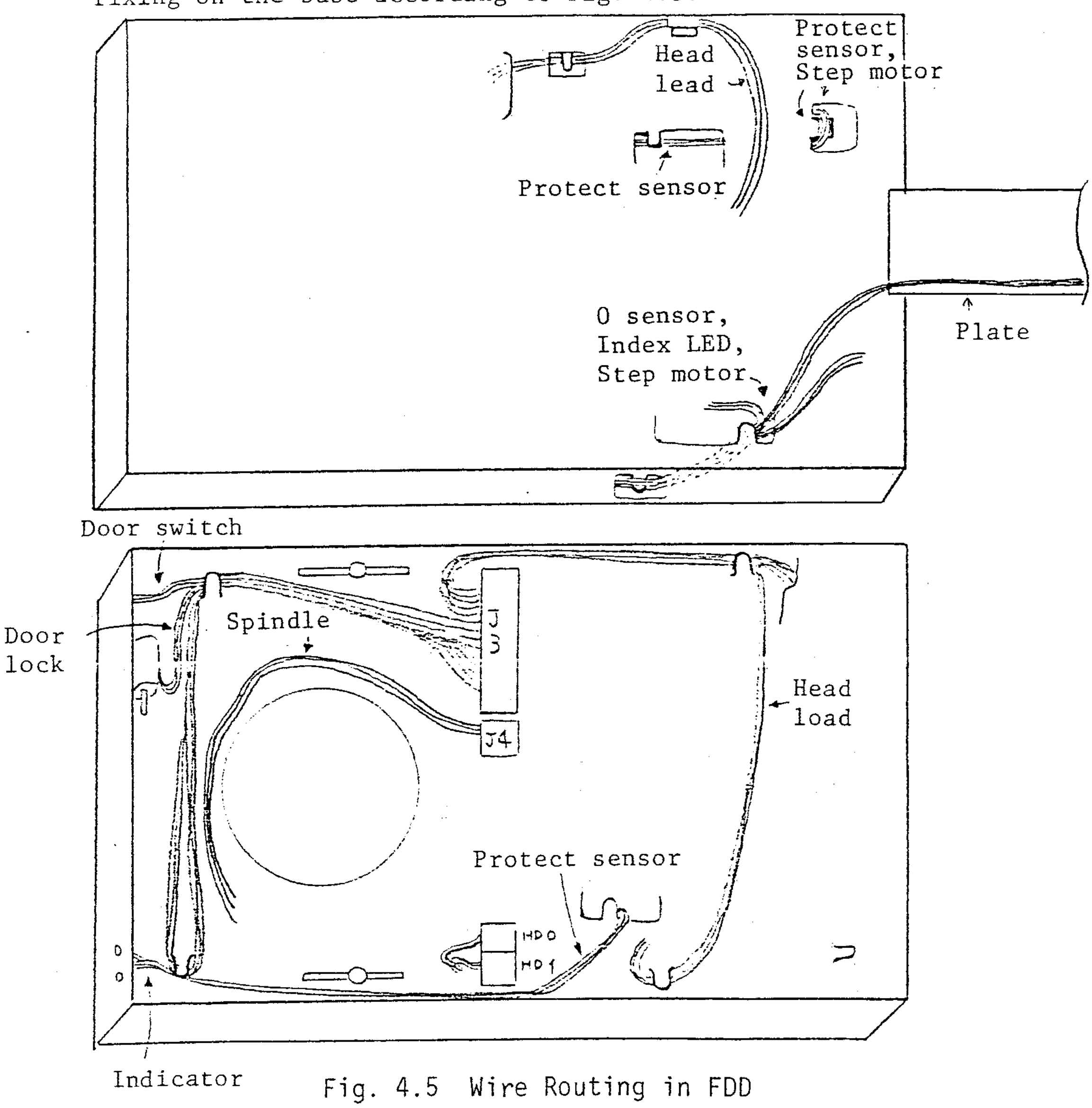


Fig. 4.5 Wire Routing in FDD

4.2.4 PWB Assembly (FCC14)

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver

(2) Disassembling

(a) Detach PWB set screws (M4 x 2).

(b) While extracting the PWB from the DD motor guide, detach connectors A, B and C. (Keep for future use the insulating plate inserted between PCB and base.)

(3) Assembling

(a) Insert connectors A, B and C into the PWB. All the connectors are each equipped with an alignment key. Check the orientation upon insertion.

(b) Insert the PWB into the DD motor guide, and secure it with the PWB set screws. (Have the insulating plate hole align with the PWB set holes.)

(4) Adjustment

(a) After replacement, set the mode according to 3.2, "Setting of FDD Operation Mode".

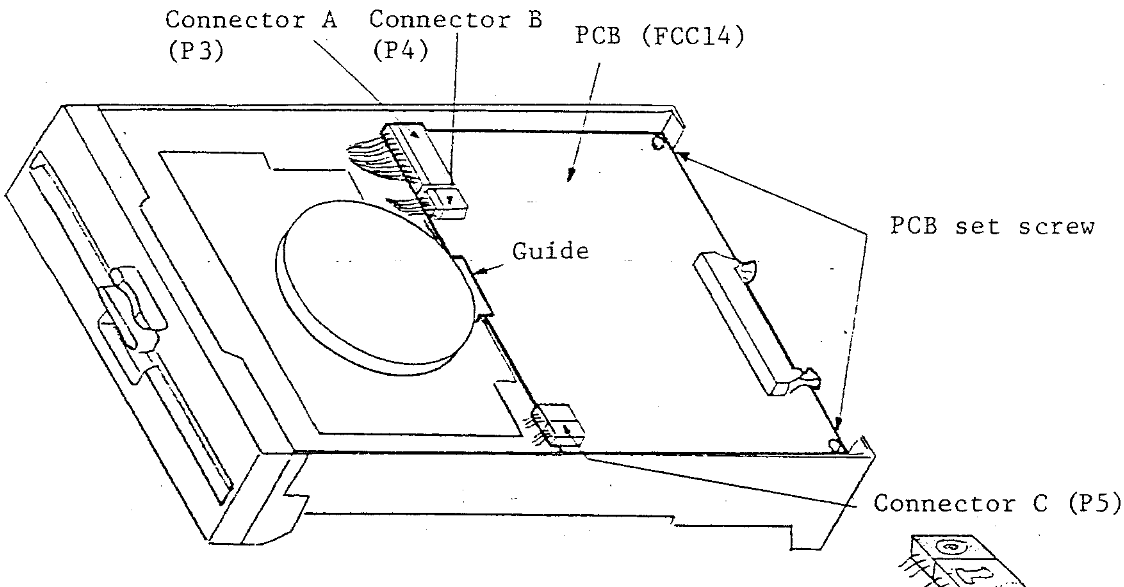


Fig. 4.6 PCB (FCC14)

4.2.5 Motor (DD Spindle)

(1) Tools and measuring instrument to be used:

- #2 Phillips screwdriver

(2) Disassembling

(a) Remove the top cover as per the procedure in 4.2.1.

(b) Open the plate as per the procedure in 4.2.2.

(c) Remove the PCB as per the procedure in 4.2.4.

(d) Remove motor set screws (M4 × 3) and extract the motor. Use care not to damage the fitting portions between motor and base which are precision-finished.

(3) Assembling

(a) With care, insert the motor straight into the base. Check the PWB guide for orientation.

(b) Secure the motor with the motor set screws.

(c) Close the plate, install the PWB, and mount the top cover.

(4) Adjustment

(a) After replacement, conduct checks or adjustment according to 4.3.1, "Head Position (Tracking) Adjustment".

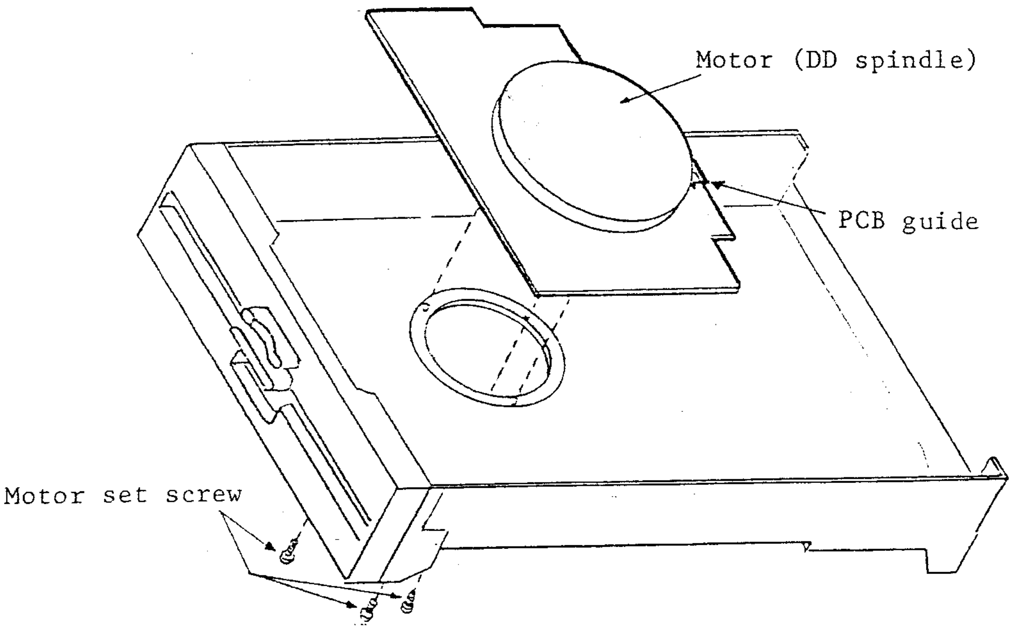


Fig. 4.7 Motor (DD Spindle)

4.2.6 Head Load Solenoid

(1) Tools and measuring instrument to be used:

- #2 Phillips screwdriver
- Small standard screwdriver (for wire removal)

(2) Disassembling

(a) Remove the top cover and open the plate according to 4.2.1 and 4.2.2.

(b) Remove the PWB according to 4.2.4.

(c) Detach the solenoid wiring from the J3 connector according to 4.2.3.

(d) Put a sheet of clean paper between head sliders to keep the head from contact.

(e) Remove head load solenoid set screws (M4 × 2). While holding the bail steady by hand, pull out the solenoid in the arrowed direction (Fig. 4.8). Use care to keep the roller in place.

(3) Assembling

(a) Holding the bail by hand, insert the solenoid gently.

(b) Tighten the solenoid set screws. At this time, check that the solenoid plate holes align with positioning dowels.

(c) Install wiring according to 4.2.3 (wire routing shown in Fig. 4.5).

(d) Close the plate, install the PWB, and mount the top cover.

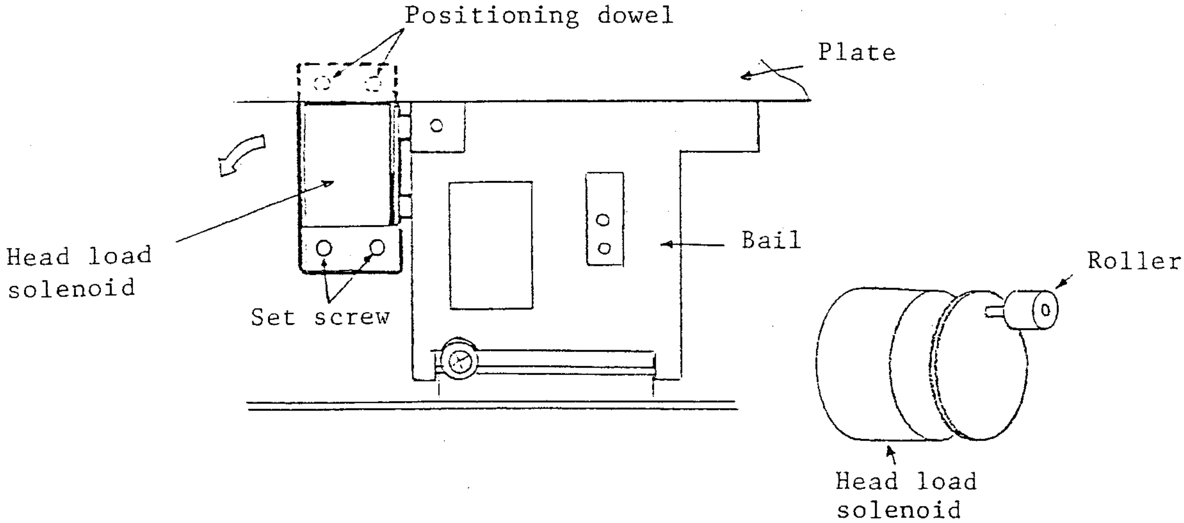


Fig. 4.8 Head Load Solenoid

4.2.7 Head Load Bail Assembly

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver
- Sheet of clean paper (for prevention of damage to head)

(2) Disassembling

(a) Remove the top cover according to 4.2.1.

(b) Open the plate according to 4.2.2.

(c) Put a sheet of clean paper between head sliders to keep the head from contact.

(d) Remove a bail set screw (M4 × 1), and pull out the bail assembly in the arrowed direction (Fig. 4.9). At this time, hold portion B of the head swing arm by hand to keep the head from any impact.

(3) Assembly

(a) Hold the head swing arm at portion B by hand to protect the head from impact. In this manner, insert the bail assembly. Use care to engage the head load solenoid axis snugly into the hole at portion A.

(b) Secure the bail assembly with the bail set screw.

(c) Close the plate and mount the top cover.

(4) Adjustment

(a) After replacement, perform adjustment according to 4.3.3, "Bail Stopper Elevation Adjustment".

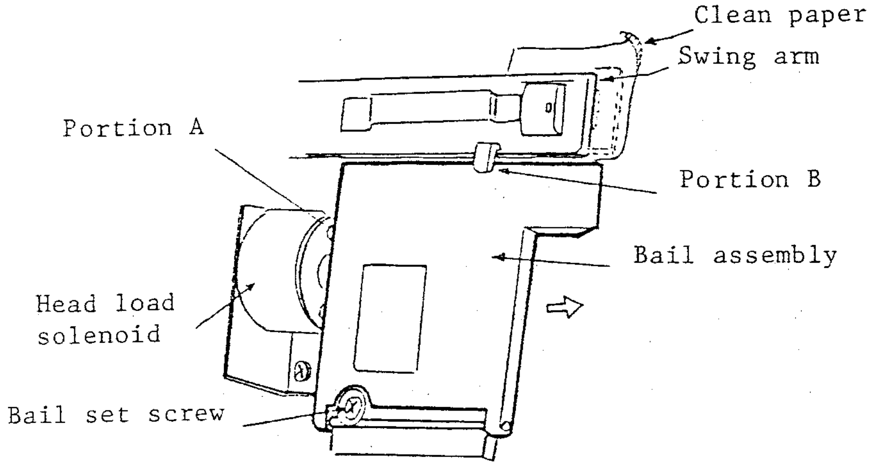


Fig. 4.9 Head Load Bail Assembly

4.2.8 0 Sensor Assembly

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver
- Small flat screwdriver (for wire removal)

(2) Disassembling

(a) Remove the PWB according to 4.2.4.

(b) Remove the 0 sensor wiring off the J3 connector according to 4.2.3.

(c) Detach a 0 sensor assembly set screw (M4 × 1).

(3) Assembling

(a) Attach the 0 sensor assembly. Press the plate in the arrowed direction (Fig. 4.10) and secure it temporarily.

(b) Install wiring according to 4.2.3 (wire routing shown in Fig. 4.5).

(c) Install the PWB according to 4.2.4.

(4) Adjustment

(a) After replacement, perform adjustment according to 4.3.2, "0 Sensor Position Adjustment".

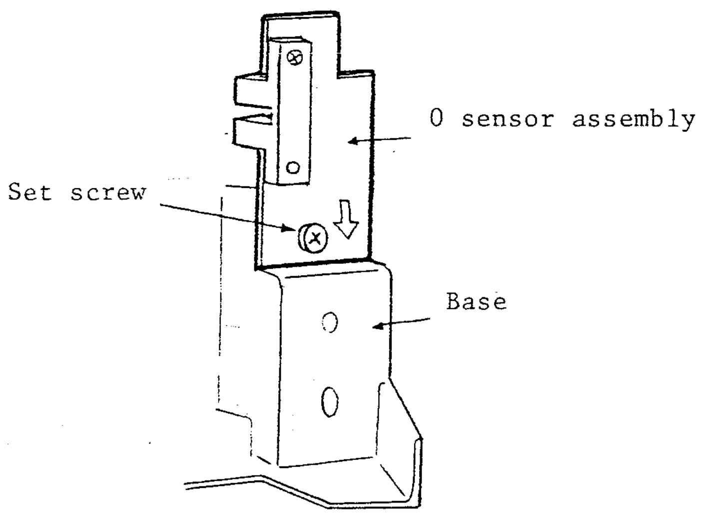


Fig. 4.10 0 Sensor Assembly

4.2.9 Protect Sensor Assembly

(1) Tools and measured instruments to be used:

- #2 Phillips screwdriver
- Small flat screwdriver (for wire removal)

(2) Disassembling

(a) Remove the PWB according to 4.2.4.

(b) Remove the protect sensor wiring off the J3 connector according to 4.2.3.

(c) Detach the bail assembly according to 4.2.7.

(d) Remove a protect sensor set screw (M4 × 1).

(3) Assembling

(a) Align the positioning dowel with the plate hole, and tighten the set screw.

(b) Attach the bail assembly according to 4.2.7.

(c) Install wiring according to 4.2.3 (wire routing shown in Fig. 4.5.)

(d) Install the PWB according to 4.2.4.

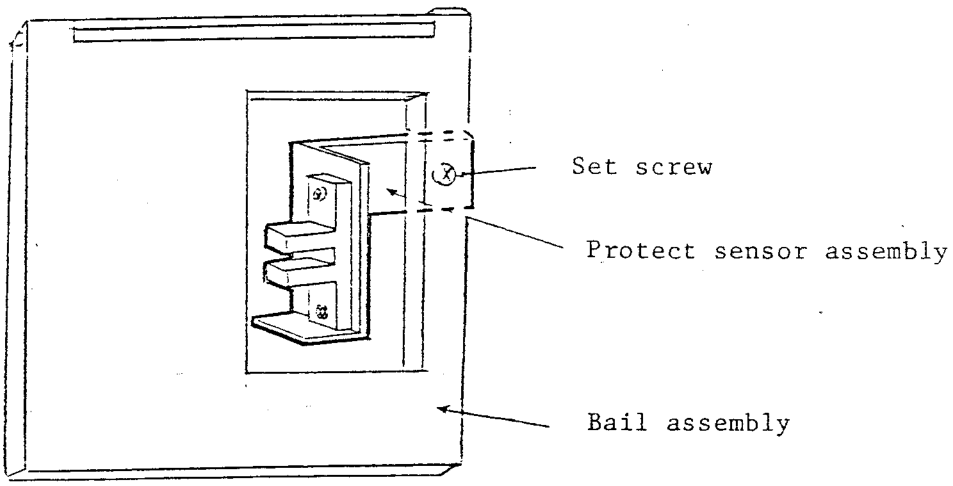


Fig. 4.11 Protect Sensor Assembly

4.2.10 Index Sensor Assembly

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver
- Small flat screwdriver (for wire removal)

(2) Disassembling

(a) Remove the top cover according to 4.2.1.

(b) Open the plate according to 4.2.2.

(c) Detach the index sensor wiring from the J3 connector according to 4.2.3.

(3) Assembling

(a) Verify that the positioning dowel is snugly engaged, and secure the index sensor together with the insulating plate.

(b) Install wiring according to 4.2.3 (wire routing shown in Fig. 4.5).

(c) Close the plate and mount the top cover.

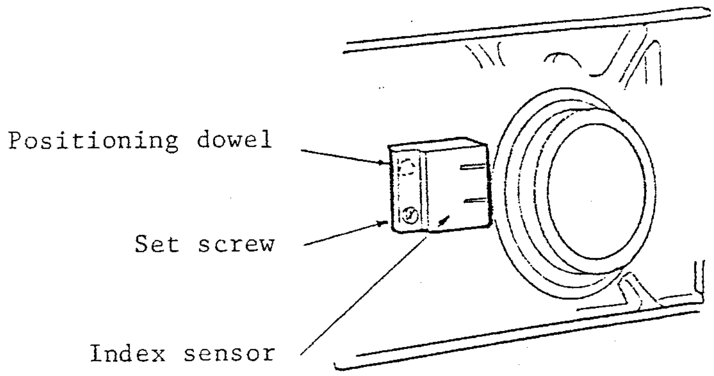


Fig. 4.12 Index Sensor

4.2.11 Index LED Assembly

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver
- Small flat screwdriver (for wire removal)

(2) Disassembling

(a) Remove the top cover according to 4.2.1.

(b) Open the plate according to 4.2.2.

(c) Detach the index LED wiring from the J3 connector according to 4.2.3.

(d) Remove an index LED set screw (M3 × 1).

(3) Assembling

(a) Mount the index LED, aligning its hole with a positioning dowel.

(b) Install wiring according to 4.2.3 (wire routing shown in Fig. 4.5).

(c) Attach the plate and top cover.

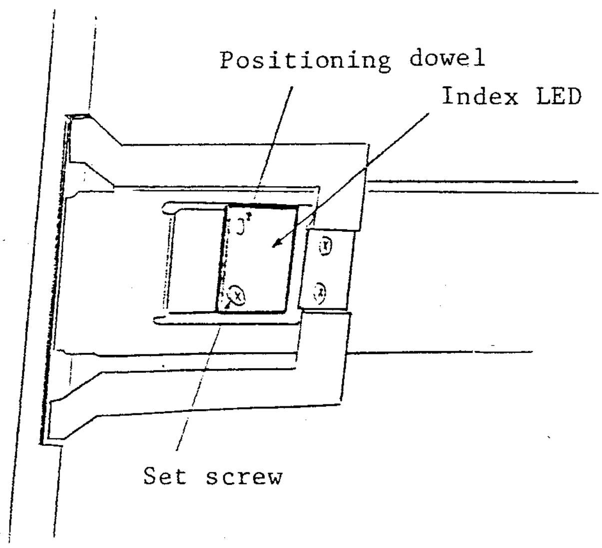


Fig. 4.13 Index LED

4.2.12 Microswitch Assembly

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver

(2) Disassembling

(a) Remove the top cover according to 4.2.1.

(b) Remove microswitch set screws (M3 × 2). Use care not to let fall the door lock assembly in the rear, which is held by the same screws.

(c) Extract a fastening terminal from the microswitch. (Before extraction, put a marking on it for correct orientation upon assembling.)

(3) Assembling

(a) Attach the fastening terminal from the microswitch.

(b) Mount the microswitch on the base. While tightening the set screws, check that the door lock assembly, held by the same screws, is also in place.

(c) After tightening the screws, close the door and check that a "click" of the switch is audible.

(d) Mount the top cover.

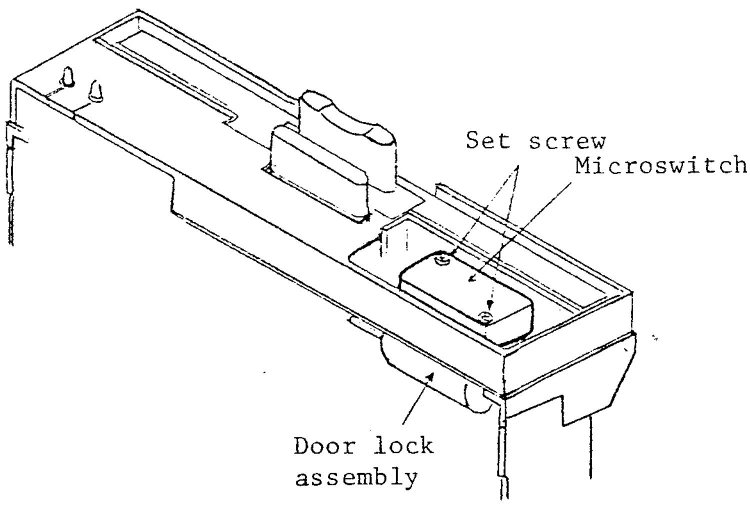


Fig. 4.14 Microswitch

4.2.13 Center Cone Assembly

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver
- E-ring mounting tool (ϕ6)

(2) Disassembling

(a) Remove the top cover according to 4.2.1.

(b) Open the plate according to 4.2.2.

(c) Detach the E-ring off the plate, and the center cone assembly, spring and washer will come off. (Keep them from scattering by holding the center cone by hand.)

Assembling

(a) Pushing the center cone assembly, spring and washer into the plate, insert the E-ring (this must be new).

(b) Close the plate and mount the top cover.

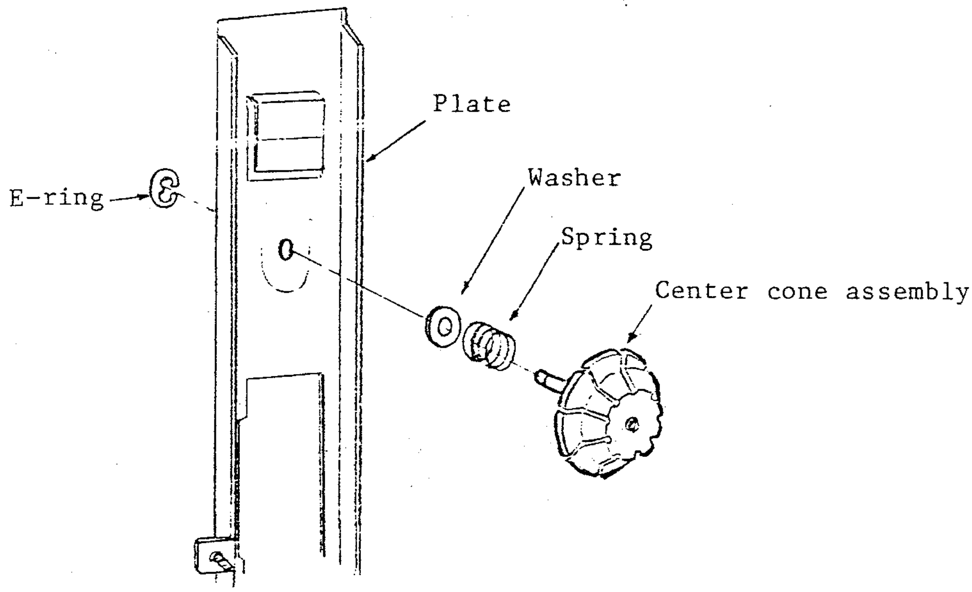


Fig. 4.15 Center Cone Assembly

4.2.14 Plate Assembly

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver

(2) Disassembling

(a) Remove the top cover according to 4.2.1.

(b) Open the plate according to 4.2.2.

(c) Detach the index LED according to 4.2.11.

(d) Remove set screws (M4 × 2) that hold the rotating shaft of the plate in place.

(e) Extract the rotating shaft, resin bush and spring.

(3) Assembling

(a) Insert the rotating shaft, resin bush and spring into the plate. Use care to orientate the spring correctly (open end on the plate side).

(b) Secure the rotating shaft with the set screws. As shown in Fig. 4.16, the set screw on the head load assembly side should be tightened together with a plate spring.

(c) Attach the index LED assembly.

(d) Close the plate and mount the top cover.

(4) Adjustment

(a) After replacement, perform adjustment according to 4.3.3, "Bail Stopper Elevation Adjustment".

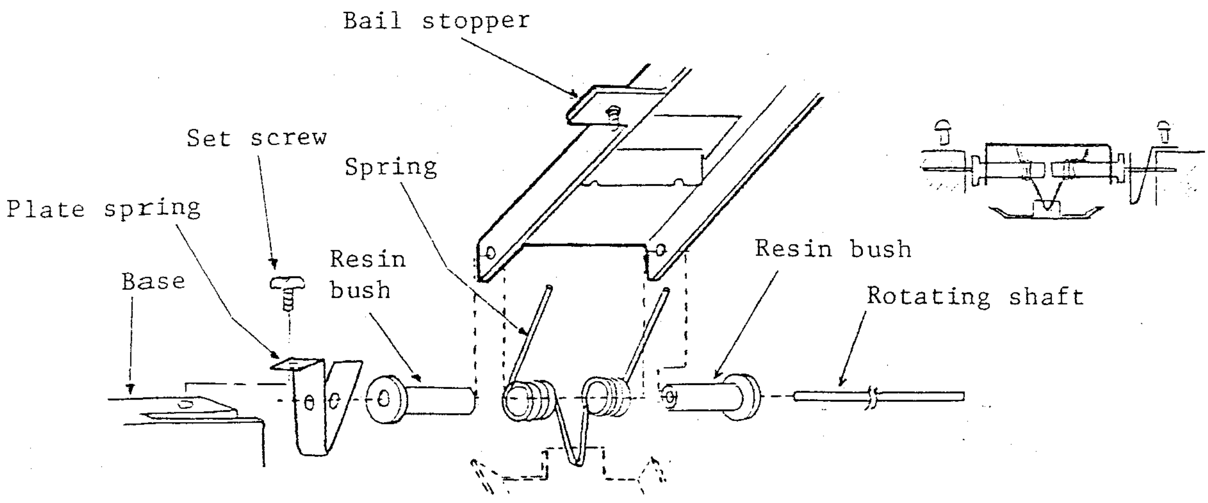


Fig. 4.16 Plate Assembly

4.2.15 Indicator Assembly

(1) Tools and measuring instruments to be used:

- Small flat screwdriver (for wire removal)

(2) Disassembling

(a) Remove the top cover according to 4.2.1.

(b) Detach the indicator assembly from the guide.

(c) Remove wiring from the J3 connector according to 4.2.3.

(3) Assembling

(a) Install wiring according to 4.2.3 (wire routing shown in Fig. 4.5).

(b) Insert the indicator assembly into the guide groove, and gently press it in the arrowed direction (Fig. 4.17).

The 1-lead LED should be on the center side.

(c) Mount the top cover.

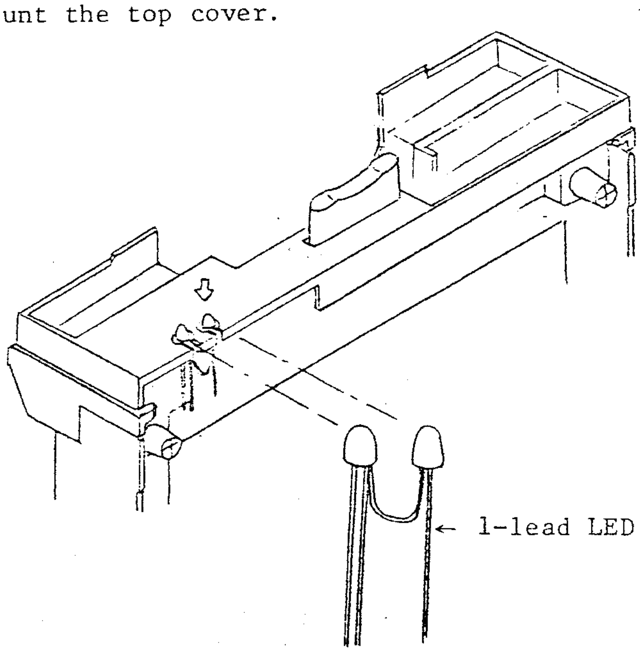


Fig. 4.17 Indicator Assembly

4.2.16 Door Lock Assembly

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver
- Small flat screwdriver (for wire removal)

(2) Disassembling

(a) Remove the top cover according to 4.2.1.

(b) Detach the solenoid wiring from the J3 connector according to 4.2.3.

(c) Remove microswitch set screws (M3 × 2), and the solenoid will come off.

(3) Assembling

(a) Tighten the microswitch set screws to secure the solenoid. At this time, press the assembly arm in the arrowed direction (Fig. 4.18) and check that the door button does not come down.

(b) Install wiring according to 4.2.3 (wire routing shown in Fig. 4.5.).

(c) Mount the top cover.

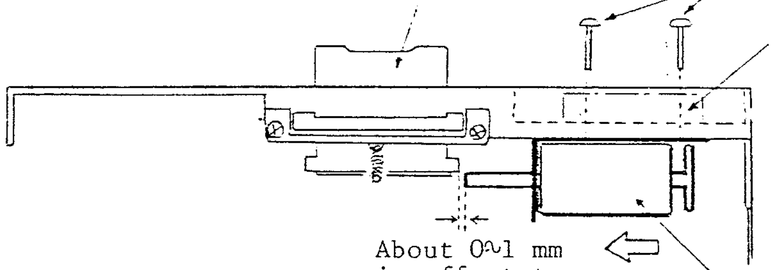


Fig. 4.18 Door Lock Assembly

4.2.17 Door Button

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver

(2) Disassembling

(a) Remove the top cover according to 4.2.1.

(b) Remove the PCB according to 4.2.4.

(c) Detach the motor (DD spindle) according to 4.2.5.

(d) Remove spring set screws (M4 × 2), and pull out the spring.

(e) Extract the latch lever.

(f) Remove the door button spring, and press down the door button to take it out.

(3) Assembling

(a) Insert the door button, and engage the door button spring.

(b) Insert the latch lever and spring, and secure them with 2 tapping screws. (Do not overtighten the tapping screws.)

(c) Install the motor (DD spindle) and PCB.

(d) Mount the top cover.

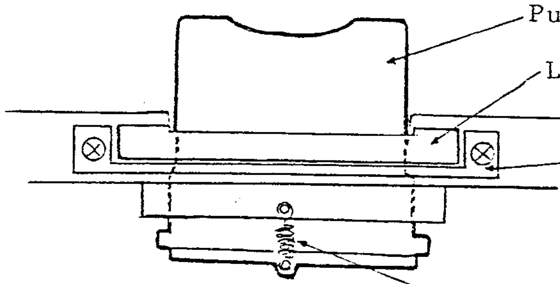


Fig. 4.19 Door Button

4.2.18 FPH-H680T Assembly

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver
- #1 Phillips screwdriver
- Spring balancer (3 kg)

(2) Disassembling

(a) Disengage the head connector from the PWB (P5).

(b) Remove the lead wire from the head lead wire clamp (see 4.2.3.).

(c) Insert clean paper between head sliders to keep the head from contact.

(d) Remove the top cover and open the plate according to 4.2.1 and 4.2.2.

(e) Detach the steel belt from the head carriage (M2.5 × 2). (Using paper tape, hold the steel belt temporarily on the step motor pulley.)

(f) Loosen clamp (guide bar) set screws (M4 × 2), extract the guide bar, and remove the assembly. At this time, never apply force onto the swing arm.

(3) Assembling

(a) Insert the guide bar into the assembly.

(b) Secure the guide bar and assembly with the clamp (guide bar) set screws. Keep the rear end of the guide bar flush with that of the clamp.

(c) Mount the steel belt on the head carriage.

(i) Loosen a screw (M2 × 1) on the step motor pulley.

(ii) Fix teh steel belt at the carriage rear end.

(iii) Fix the steel belt temporarily at the carriage front end.

(iv) Engage the spring balancer in a hole at the steel belt front end. While pulling the balancer straight at 2.0 ± 0.3 kg, tighten the screw at the carriage front end.

(v) Move the carriage twice or more over the entire stroke. Then tighten the screw on the step motor pulley.

(vi) Move the carriage again over the entire stroke, and check that the belt is held taut and straight. (If the belt is not taut enough or straight enough, repeat steps (iv) and (v).)

(d) Clamp the head lead wire according to Fig. 4.5 in 4.2.3.

(e) Close the plate, mount the top cover, and insert the head connector into the PWB.

(4) Adjustment

(a) After replacement, perform adjustment according to 4.3.1, "Head Position (Tracking) Adjustment" and 4.3.2, "0 Sensor Adjustment".

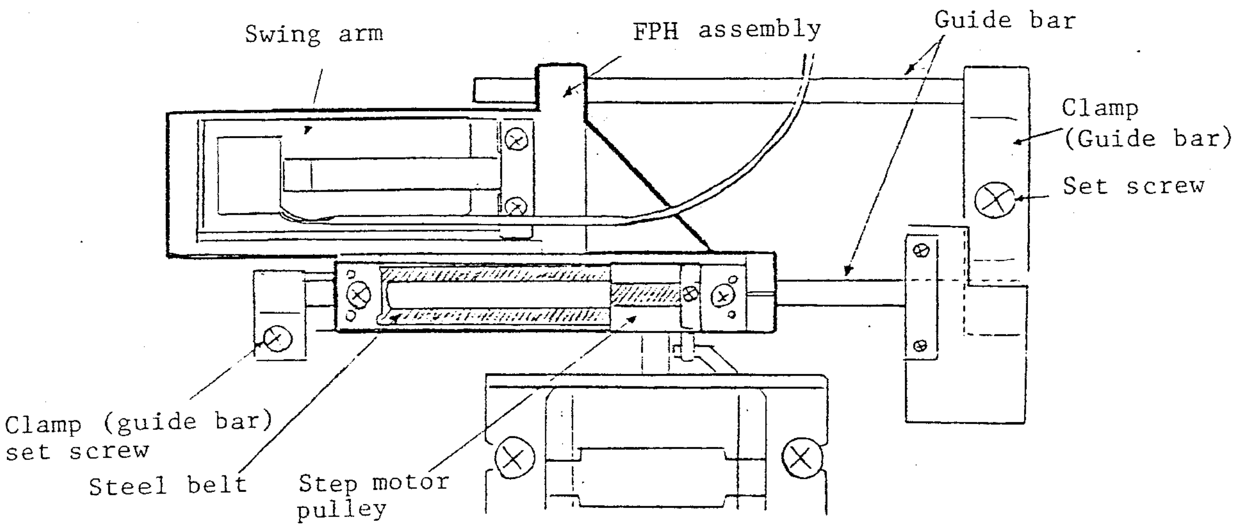


Fig. 4.20 FPH Assembly

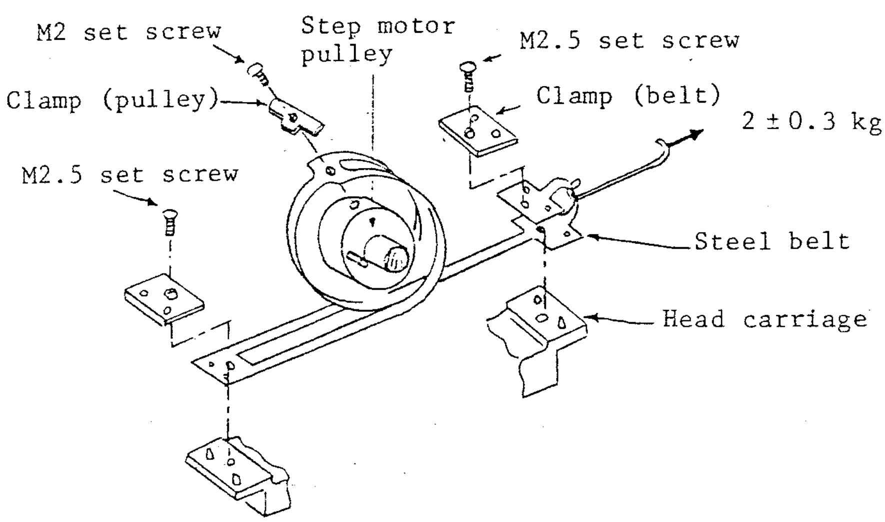


Fig. 4.21 How to Install Steel Belt

4.2.19 Step Motor

(1) Tools and measuring instruments to be used:

- #2 Phillips screwdriver
- #1 Phillips screwdriver
- Small flat screwdriver (for wire removal)
- Spring balancer (3 kg)

(2) Disassembling

(a) Remove the PWB according to 4.2.4.

(b) Remove the step motor wiring from the J3 connector according to 4.2.3.

(c) Detach the steel belt from the head carriage and step motor pulley.

(d) Remove step motor set screws (M4 × 2) to dismount the step motor.

(3) Assembling

(a) Mount the step motor with the set screws. At this time, press it in the arrowed direction (Fig. 4.22) and hold it temporarily.

(b) Engage the steel belt through the head carriage and step motor pulley.

(i) Hold the steel belt temporarily onto the step motor pulley. (Keep the screw slack.)

(ii) Fix the steel belt at the carriage rear end.

(iii) Secure the steel belt temporarily at the carriage front end.

(iv) Engage the spring balancer in a hole at the steel belt front end. While pulling the balancer straight at 2.0 ± 0.3 kg, tighten the screw at the carriage front end.

(v) Move the carriage twice or more over the entire stroke. Then tighten the screw on the step motor pulley.

(vi) Move the carriage again over the entire stroke, and check that the belt is held taut and straight. (If the belt is not taut enough or straight enough, repeat steps (iv) and (v).)

(c) Install the step motor wiring according to 4.2.3 (wire routing shown in Fig. 4.5).

(d) Mount the PWB according to 4.2.4.

(4) Adjustment

(a) After replacement, perform adjustment according to 4.3.1, "Head Position (Tracking) Adjustment" and 4.3.2, "0 Sensor Adjustment".

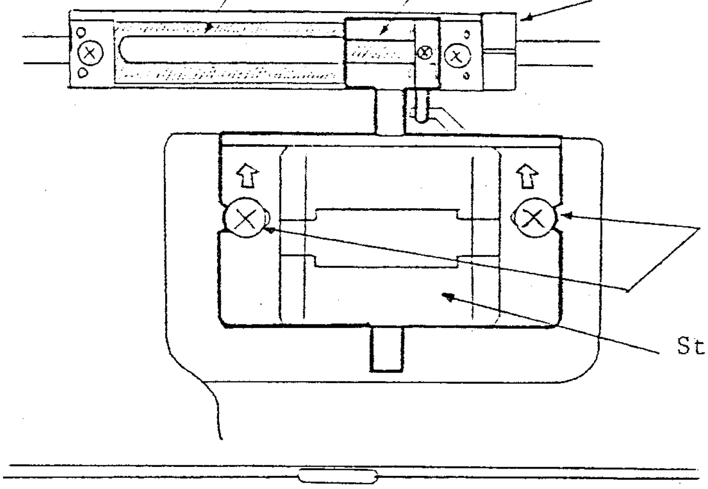


Fig. 4.22 Step Motor

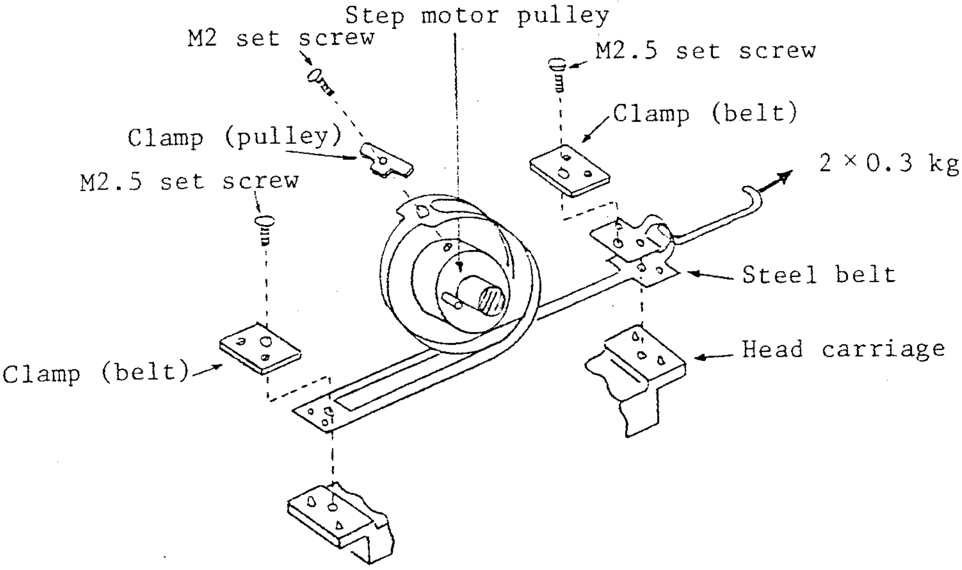


Fig. 4.23 How to Install Steel Belt

4.3 Adjustment Procedures

4.3.1 Head Position (Tracking) Adjustment

(1) Objective and setting requirements

The magnetic heads are made to align correctly with the medium in track position.

The setting requirements involve the distance between track #38 (middle between 0 and 78) and the spindle center (given below). There requirements are to be met by following the adjustment procedure of (3) below.

Side 0 head $r = 71.645 \begin{smallmatrix} +0.06 \text{ mm} \\ -0.04 \text{ mm} \end{smallmatrix}$

Side 1 head $r = 69.529 \begin{smallmatrix} +0.06 \text{ mm} \\ -0.04 \text{ mm} \end{smallmatrix}$

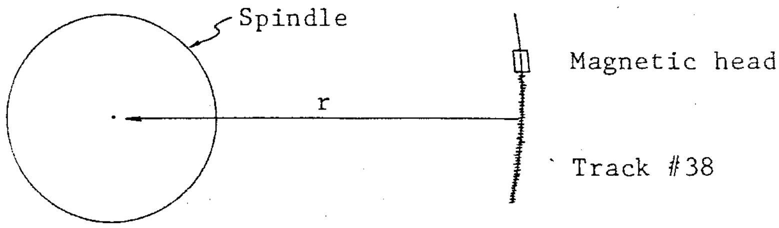


Fig. 4.24 Head Position (Tracking) Setting Requirements

(2) Tools and measuring instruments to be used

(a) CE medium

(b) #2 Phillips screwdriver

(c) Synchroscope (1 : 1 probe × 3)

(d) Shorting-plug

(e) Tester or system

(i) Sides 0 and 1 should be switchable.

(ii) Seek should be available on tracks #0 to 38 to 76.

(iii) Head loading on/off operation should be possible.

(iv) DC power supply should be available.

(3) Adjustment procedure

(a) Turn off DC power supply. Position the FDD vertically as shown in Fig. 4.25.

(b) Turn the shaft at the step motor rear end to move the head carriage toward the outermost track, until the step motor pulley pin hits a stopper on the step motor keep plate. (At this time, do not touch the head carriage, drive pulley and steel belt.)

(c) Turn on DC power supply and insert the CE medium.

(d) Short-circuit JP2 at 4 and 6 with a shorting-plug to excite phase 0 of the step motor.

(Steps (a) to (d) above are carried out to initialize the carriage onto track 0.)

(e) Ste the synchroscope.

CH-1/2 : Observe the waveform at TP1 and 2 with the differential mode. (V: 50mV/div., H: 10 ms/div.)

EXT TRG: Set to TP11. (INDEX-P)

(f) Load the head on and check that a head output waveshape appears.

If no waveshape appears, move the step motor a bit lightwise, and hold it temporarily where a waveshape is output.

(g) Remove the shorting-plug installed in step (d) above.

(h) Seek track #38 and load the head on.

(i) Move the step motor a bit so that the head read output reaches a maximum. (The output voltage is to be the peak value 20 ms away form the index.) Note down this output voltages as V_{0max}.

(j) Switch sides 0 and 1 and obtain V_{1max}, as in step (i).

(k) Find values 85% of V_{0max} and V_{1max} measured in steps (i) and (j) above.

$V_0 = 0.85V_{0max}$

$V_1 = 0.85V_{1max}$

(l) Again move the step motor bit by bit, switch sides 0 and 1 for observation, and find settings such that the output voltage comes between 85% and 100% for both side 0 and side 1.

$V_{0max} \geq$ setting $v_0 \geq \underline{V_0}$

$V_{1max} \geq$ setting $v_1 \geq \underline{V_1}$

(m) Tighten the set screws on the step motor alternately to secure the motor. (Tighten the screws while observing the output waveshape, so that no positional displacement will occur.)

(n) Repeat the head loading operation several times. Measure the head output voltage again, and check that the settings (v_0, v_1) in step (m) above are met.

(o) Conduct track seeks of 38 → 0 → 38 and 38 → 76 → 38. Measure the head output voltage again, and confirm the settings (v_0, v_1) in step (m) above are met.

(4) Cautions

(a) The CE medium should be under the following conditions for at least 30 minutes before use:

Temperature: 23°C ± 3°C
Humidity : 50% ± 10% RH

(b) Do not leave the CE medium mounted for extended periods of time.

(i) Replace every medium after 250 usages.

(ii) Should the read voltage become 70% or less of the initial value, replace the medium even if the 250 usage count is not yet reached.

(iii) If the center hole is found damaged, replace the medium at once.

(c) When moving the step motor, keep it along the reference surface.

(When the FDD is positioned vertically as shown in Fig. 4.25, the step motor presses itself onto the surface under its own weight.)

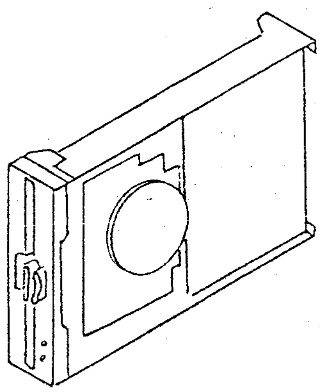


Fig. 4.25 Positioning the FDD for Adjustment

4.3.2 0 Track Sensor Position Adjustment

(1) Objective and setting requirements

When the carriage returns to track #0, the TRACK 00 signal should be properly sensed.

(2) Tools and measuring instruments to be used

(a) Work medium

(b) #2 Phillips screwdriver

(c) Synchroscope (1 : 1 probe × 2)

(d) Shorting-plug

(e) Tester or system

[(i) Seek should be repeatedly possihle on tracks #0 to 4 to 0.

(ii) DC power supply should be available.]

(f) IC clips (standard 14-pin type × 2, or 28-pin type × 1)

(3) Adjustment

(a) Turn off DC power supply.

(b) Turn the shaft at the step motor rear end to move the head carriage towrad the outermost track, until the step motor pulley pin hits the stopper on the step motor keep plate. (At this time, do not touch the head carriage, drive pulley and steel belt.)

(c) Turn on DC power and insert the work medium.

(d) Short-circuit JP2 at 4 and 6 with a shorting-plug to excite phase 0 of the step motor.

(Steps (a) to (d) above are carried out to initailize the carriage onto track #0.)

(e) Set the synchroscope.

CH-1: TRACK 00-P (IC14-12 pin or IC12-22 pin)
CH-2: STEP-N (IC5-11 pin or IC12-7 pin)

(f) Remove the shorting-plug installed in step (d) above.

(g) Loosen the set screw on the 0 track sensor, and move the sensor toward the outermost track (i.e., away from the spindle).

(h) Move the 0 track sensor bit by bit toward track #76, and hold it temporarily where the TRACK 00 signal is brought "High" for the first time.

(i) Repeat seek operation on track #0 to 4 to 0, and fine-adjust the sensor position so that the TRACK 00-P signal and STEP signal appear in such a relation to each other as shown in Fig. 4.26. This adjustment is made easier by following the steps given below:

(i) Set the range of the synchroscope to 2V/div., 2 ms/div.

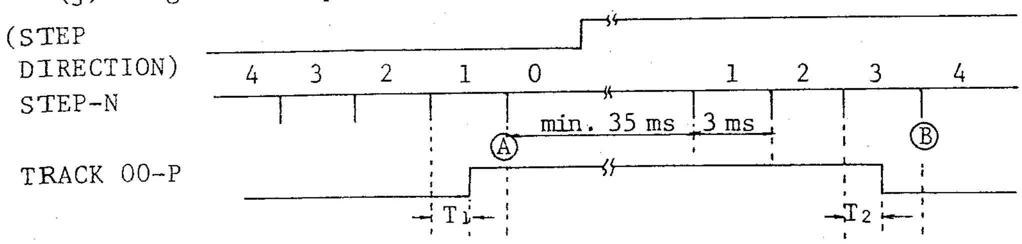
(ii) Get a correct synchronization with the STEP-N signal at CH-2.

(iii) Turn the time axis rheostat to adjust the time axis so that the waveshape shown in Fig. 4.27 appears.

(That is, synchronization is effected alternately at points Ⓐ and Ⓑ in Fig. 4.26.)

(iv) Positioning should be such that time T in Fig. 4.27 becomes 0.

(j) Tighten the plate set screw.



· $T_1 = T_2 \pm 0.3$ ms
· T_1 , $T_2 \leq 3$ ms

Fig. 4.26 0 Sensor Position Adjustment Timing (1)

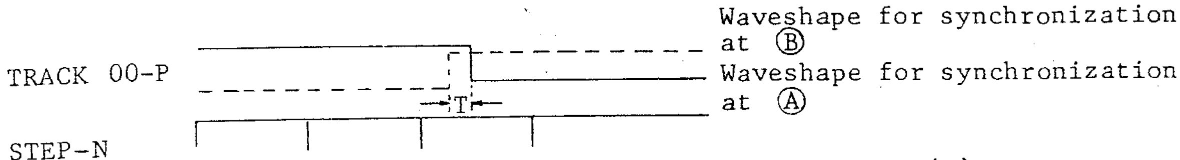


Fig. 4.27 0 Sensor Position Adjustment Timing (2)

4.3.3 Bail Stopper Elevation Adjustment

(1) Objective and setting requirements

The bail elevation should be such that the head engage operation is completed within 50 ms and that the medium and the heads are positively separated upon head loading-off.

(2) Tools and measuring instruments to be used:

(a) Work medium (with minimum bend or distortion)

(b) 1.5 mm hexagon wrench

(c) Synchroscope (1 : 1 probe × 3)

(d) Tester or system

[(i) Seek should be available on track #0-76.

(ii) DC power supply should be available.

(iii) Head loading-on/off operations should be possible.]

(e) IC clips (standard 14-pin type × 1, or 28-pin type × 1)

(3) Adjustment

(a) Turn on DC power supply and seek track #0.

(b) Set the synchroscope.

CH-1/2 : For differential observation at TP1/2 (50mV/div., 10 ms/div.)

EXT TRG: HEAD ENGAGE-N (IC1-2 pin or IC12-12 pin)

(c) Using the hexagon wrench, turn the bail elevation adjust screw slowly clockwise. Check that the output voltage becomes equal to that of a head loading on.

(d) Then turn the bail elevation adjust screw slowly counterclockwise, and set it where the read output voltage disappears (5% or less of the value in head loading state).

At this time, use care not to press the wrench onto the bail.

(e) Give another 1.5 counterclockwise turns to the bail elevation adjust screw that was set in step (d).

(f) Seek track #76 and check that no output waveshape appears. Should an output waveshape be observed, turn the bail elevation adjust screw bit by bit counterclockwise, and set it where the waveshape disappears.

(g) Load the heads on and check that 80% or more of the output waveshape appears within 50 ms after the head loading on.

(4) Cautions

(a) Never touch the bail elevation adjust screw except for adjustment purposes.

(b) Use a work medium with minimum bend or distortion, such that the waveshape shown in Fig. 4.28 does not appear while the adjust screw is turned counterclockwise.

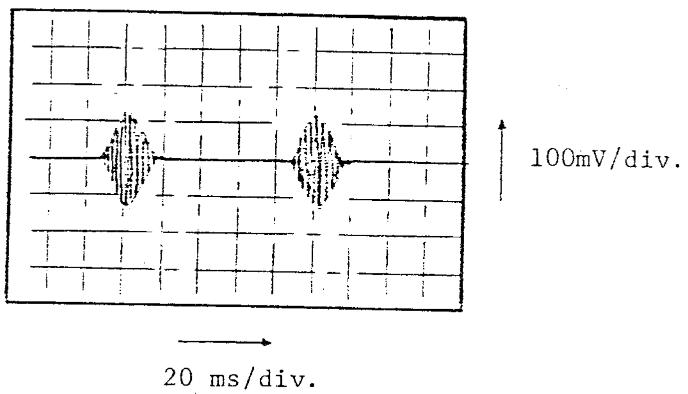


Fig. 4.28 Output Waveshape from Bent or Distorted Medium

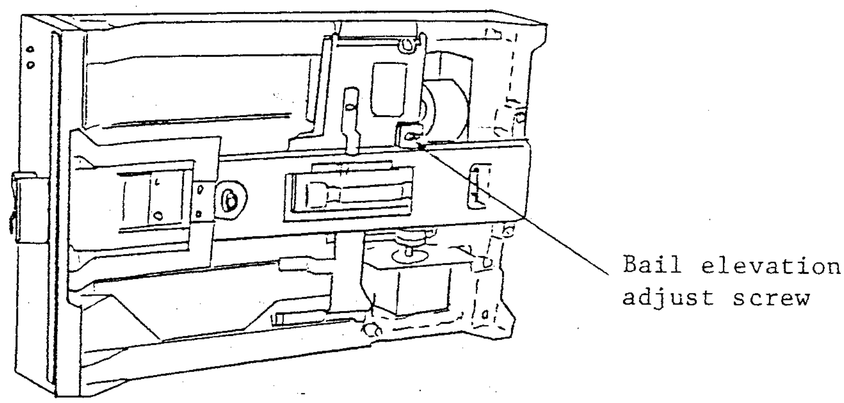


Fig. 4.29 Bail Elevation Adjustment

5. TROUBLESHOOTING

5.1 Troubleshooting Flowchart

Objective: To minimize the repair time upon FDD error

Notes on use

(1) This flowchart covers only the cases in which, upon system error, its cause is suspected to exist in the FDD.

(2) FDD usages (i.e., control methods) vary depending on the system. It follows that not all paths may be applied to a specific configuration. In such a case, the flowchart serves solely as a rule-of-thumb guideline for maintenance.

(3) Keep the error information that was output on a console typewriter or other devices upon error.

(4) In case of a data-related error, keep intact the contents of the recorded surface at the time of the error. That is, do not write data into the track applicable to the error until the error is remedies. The knowledge that an abnormal output waveshape was present or absent upon error, and/or details of how the error occurred can be very helpful and may serve as a key to finding what caused the error.

(5) In the flowchart, the abbreviations and numbers in parantheses indicate measuring points.

Example:	(TP-7)	Test point
	(J3-7)	Pin 7 of J3 connector
	(IC2-7)	Pin 7 of IC2

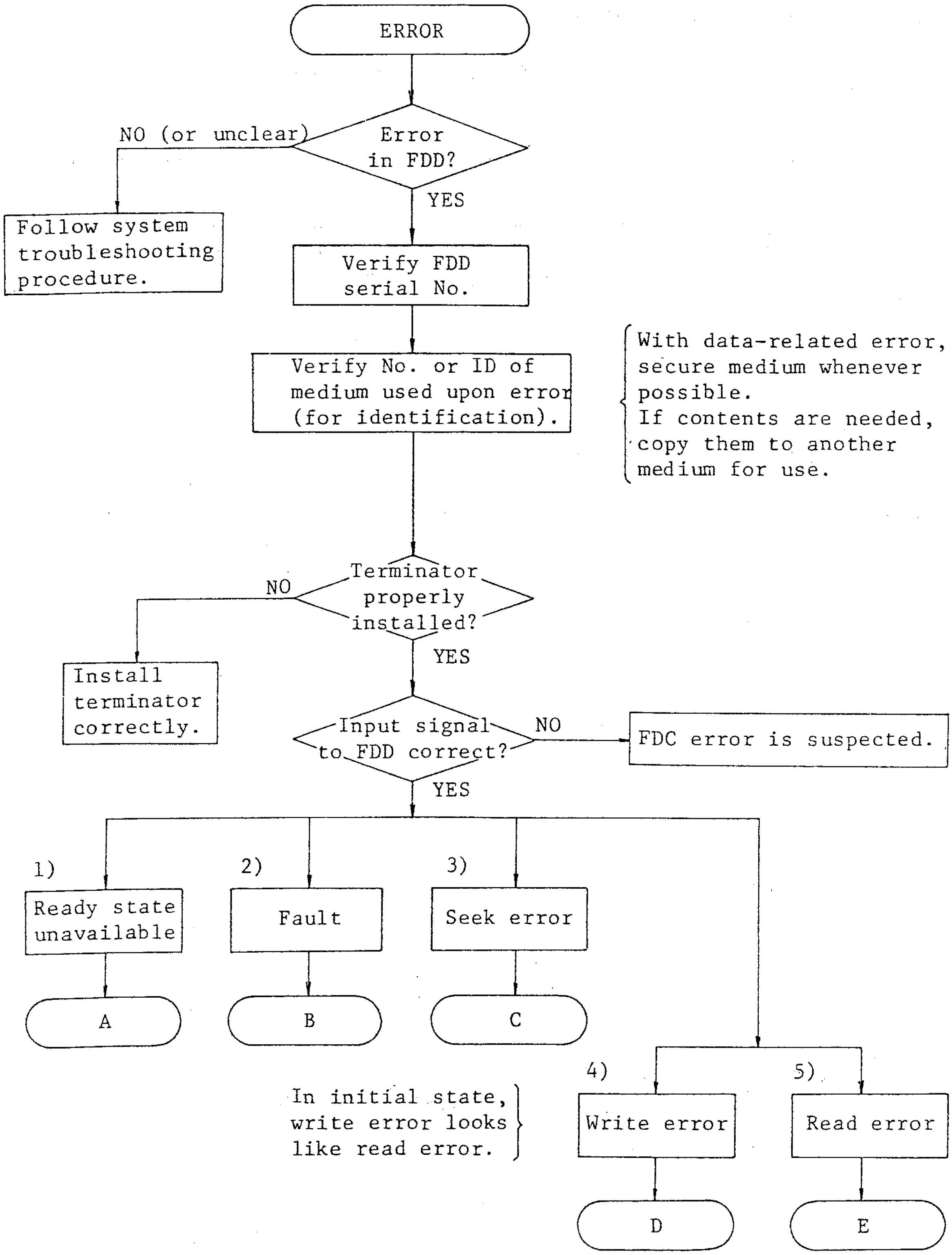


Fig. 5.1 Error Separation

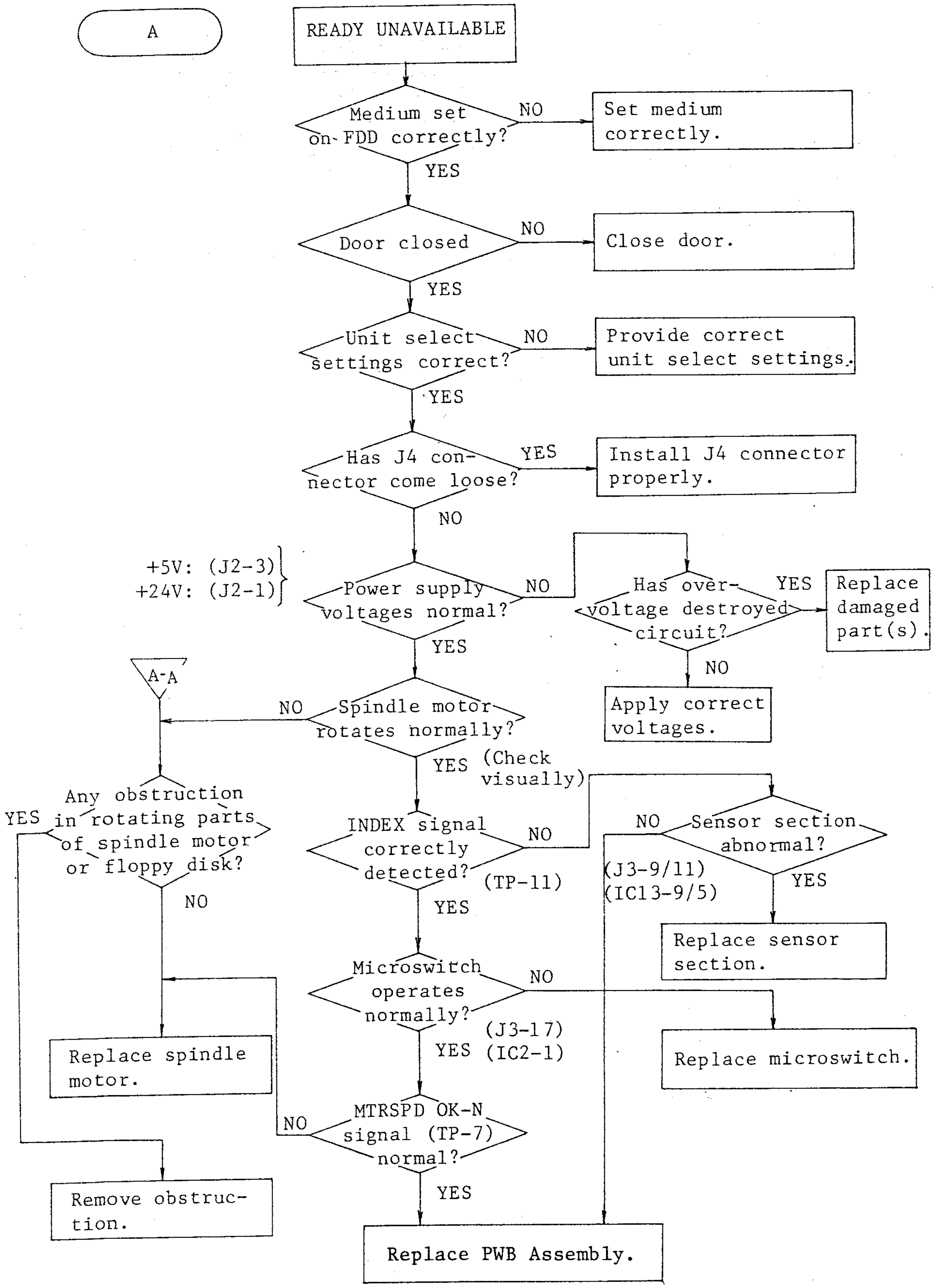


Fig. 5.2 Ready State Unavailable

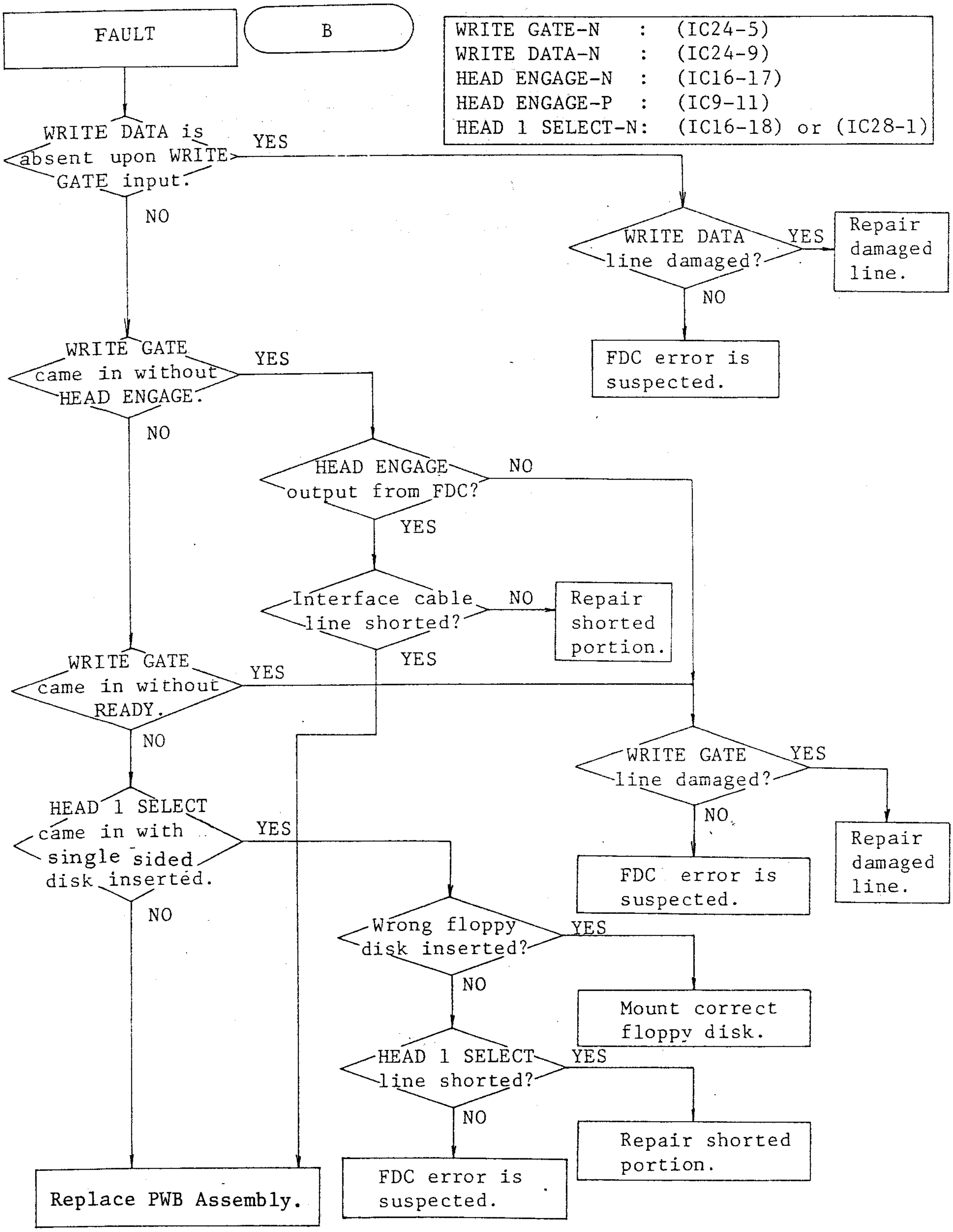

FAULT
B
WRITE GATE-N : (IC24-5)
WRITE DATA-N : (IC24-9)
HEAD ENGAGE-N : (IC16-17)
HEAD ENGAGE-P : (IC9-11)
HEAD 1 SELECT-N: (IC16-18) or (IC28-1)
WRITE DATA is absent upon WRITE GATE input?
YES
NO
WRITE DATA line damaged?
YES
Repair damaged line.
NO
FDC error is suspected.
WRITE GATE came in without HEAD ENGAGE.
YES
NO
HEAD ENGAGE output from FDC?
NO
YES
Interface cable line shorted?
NO
Repair shorted portion.
YES
WRITE GATE came in without READY.
YES
NO
WRITE GATE line damaged?
YES
NO
FDC error is suspected.
Repair damaged line.
HEAD 1 SELECT came in with single sided disk inserted.
YES
NO
Wrong floppy disk inserted?
YES
NO
Mount correct floppy disk.
HEAD 1 SELECT line shorted?
YES
NO
Repair shorted portion.
Replace PWB Assembly.
FDC error is suspected.

Fig. 5.3 Fault

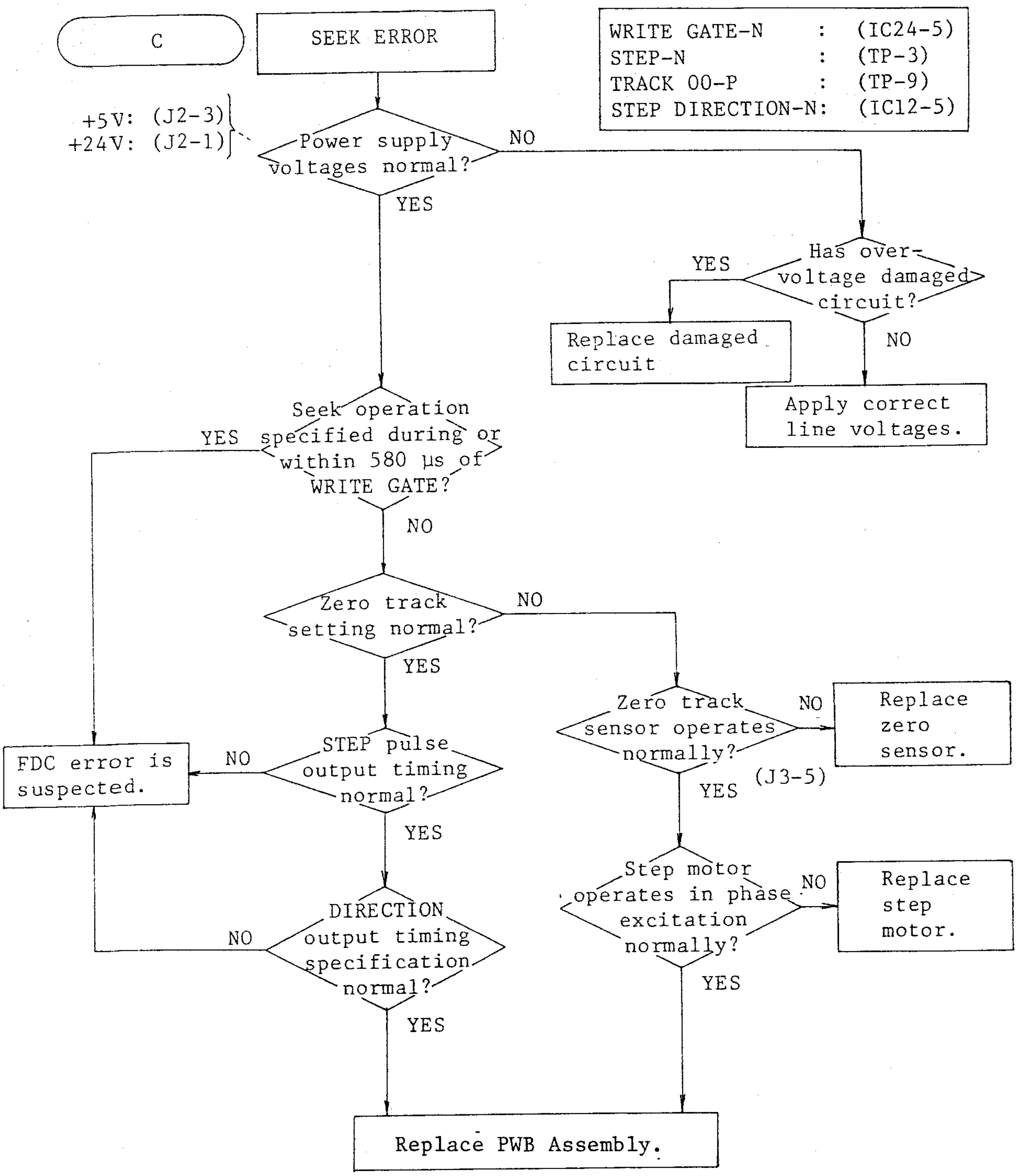


Fig. 5.4 Seek Error

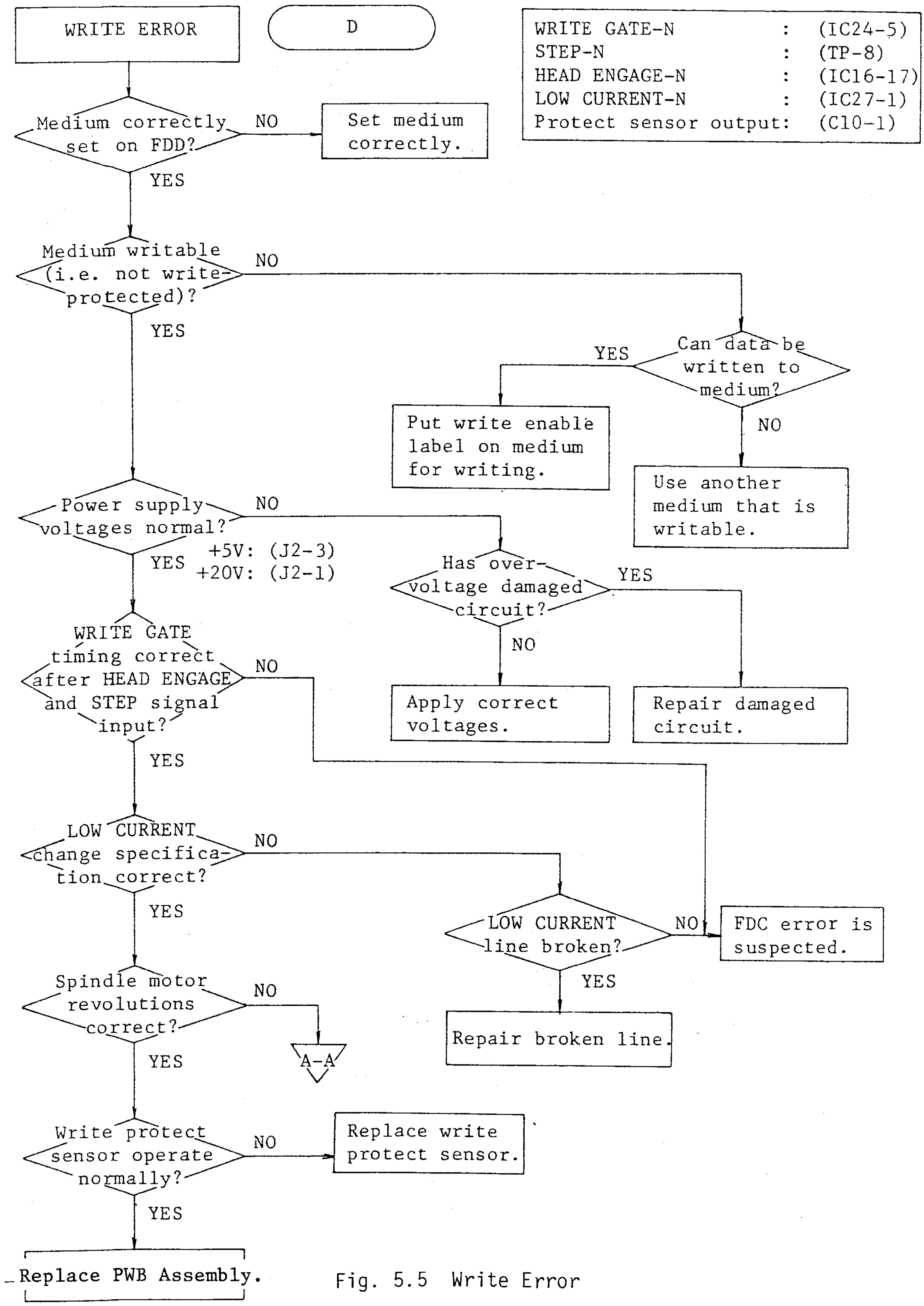
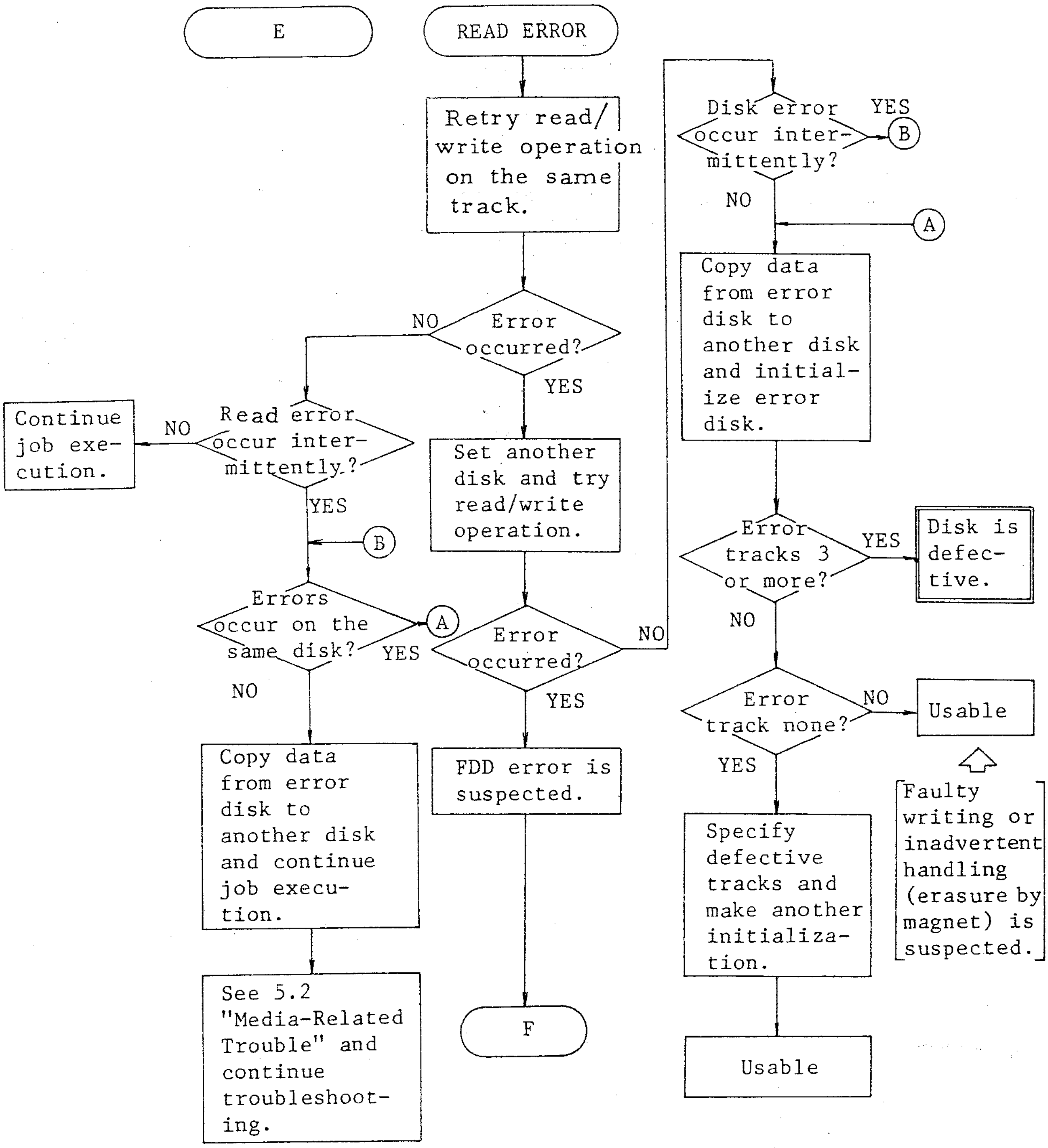


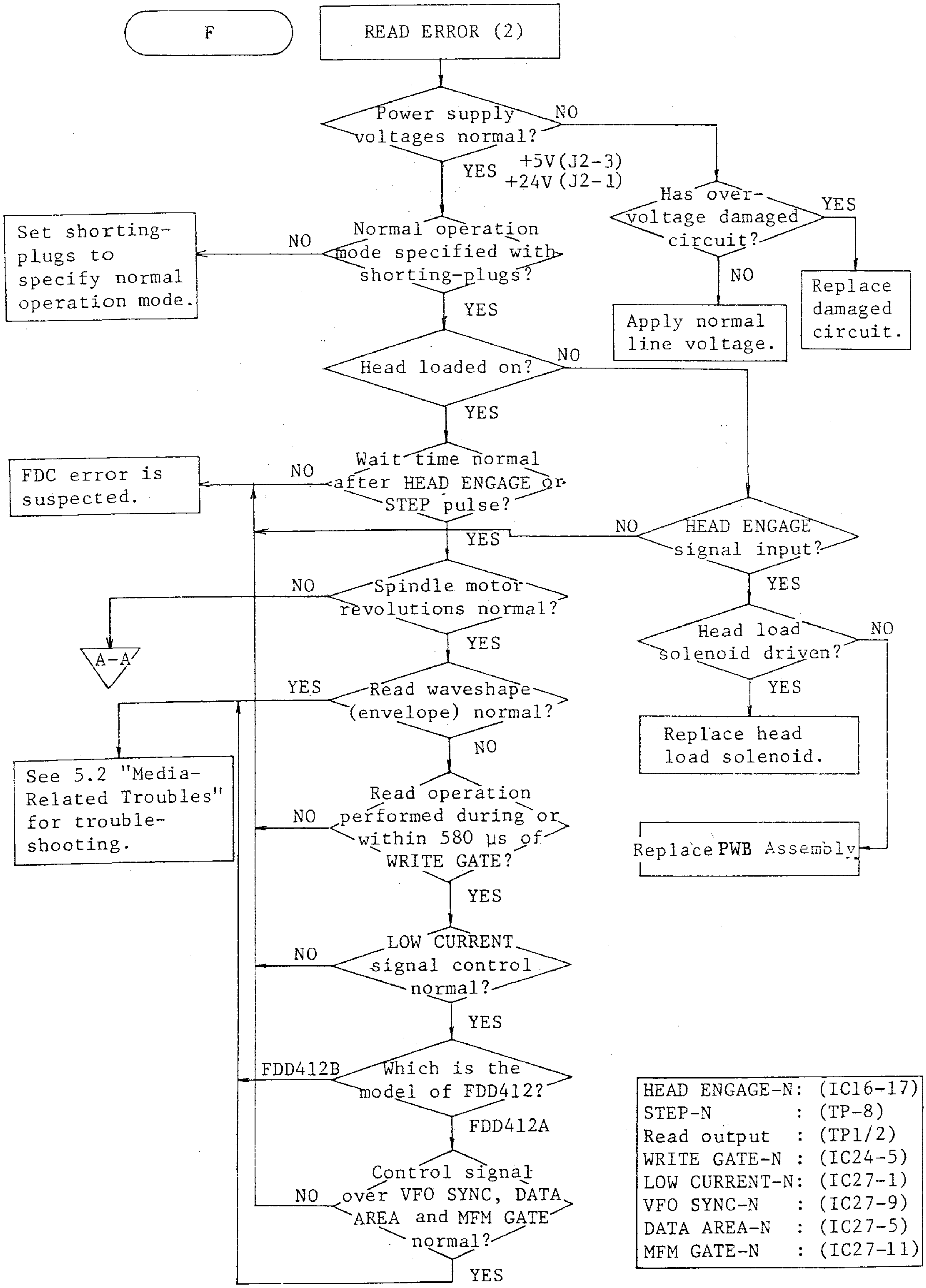
Fig. 5.5 Write Error



Prepared way to separate errors at stage A

Referring to 5.2, "Media-Related Troubles", use a synchroscope to observe waveshapes from error addresses on the disk.

Fig. 5.6 Read Error (1)



HEAD ENGAGE-N	:	(IC16-17)
STEP-N	:	(TP-8)
Read output	:	(TP1/2)
WRITE GATE-N	:	(IC24-5)
LOW CURRENT-N	:	(IC27-1)
VFO SYNC-N	:	(IC27-9)
DATA AREA-N	:	(IC27-5)
MFM GATE-N	:	(IC27-11)

Fig. 5.7 Read Error (2)

5.2 Media-Related Troubles

5.2.1 Outline

Today, the floppy disk is filling the major role as storage media for small business computers, various terminal devices and peripherals.

This trend may be a natural choice as a result of the disk's various advantages including easy handling and random access capabilities, unlike conventional media such as punched cards, paper tapes and magnetic tapes.

However, inadvertent handling often results in damages on the recording surface; it consists of fine oxide powder bonded with special bonding agent (binder) on a thin polyester film (about 75 µm thick).

The disk is protected in a jacket composed of bonded fabric (liner) coated with vinyl chloride. Because the floppy disk is mounted on a FDD together with its jacket, the quality of the jacket also affects performance.

There are numerous floppy disk manufacturers in the world. Small but noticeable differences are recognized in physical and electric properties from one manufacturer's product to another.

Media-related troubles are generally divided into four categories:

(1) Troubles due to inadvertent handling (damage, bend, etc.)

(2) Troubles attributable to production process

(3) Defective device by which to write data into medium

(4) Defective device by which to read data from medium

Troubles that fall in category (1) are particularly frequent. One study reports that 60% or more of all troubles in a given period fell in this category.

When a data-related error occurred while an FDD was being used, it often proves difficult to determine, from the user's explanation alone, whether the cause is in the drive or on medium.

To separate the trouble positively to the drive or to the medium requires observing the actual status of magnetic recording.

5.2.2 Troubleshooting Procedure

(1) Read out a waveshape from the defective portion on the medium in use at the time of the error.

(2) Find a similar waveshape from the pictures in 5.2.3.

(3) Find in 5.2.4 the typical failure with its description corresponding to the picture, and determine what caused the error.

5.2.3 Pictures of Normal/Abnormal Readout Waveshapes

(1) Waveshape observation points

CH1 : TP1 (READOUT 1)
CH2 : TP2 (READOUT 2)
EXT TRG: TP11 (INDEX-P)

(2) Synchroscope settings

CH2 : INVERT
MODE: ADD
Differential observation
VOLT: 100mV/div.
TIME: 5 µs ∿ 20 ms/div.

(3) Picture list

(a) FM method : $(00)_{16}$ track, $(FF)_{16}$ gap (normal)

(b) MFM method: $(00)_{16}$ track, $(4E)_{16}$ gap (normal)

(c) FM method : $(00)_{16}$ track, $(00)_{16}$ data (normal)

(d) FM method : $(4C)_{16}$ track, $(FF)_{16}$ data (normal)

(e) Drop-out (example) (abnormal)
~
(j)

(k) Example of defective envelope (wavy) (abnormal)
~ (example)
(l)

(m) Defective data cycle (example) (abnormal)

(n) Different amplitude between ID, (abnormal)
~ and Data parts (example)
(p)

(q) Abnormal flux change (example) (abnormal)
~
(s)

(t) Noise (abnormal)
~
(w)

(a) FM method: Normal waveshape of $(00)_{16}$ track, $(FF)_{16}$ data

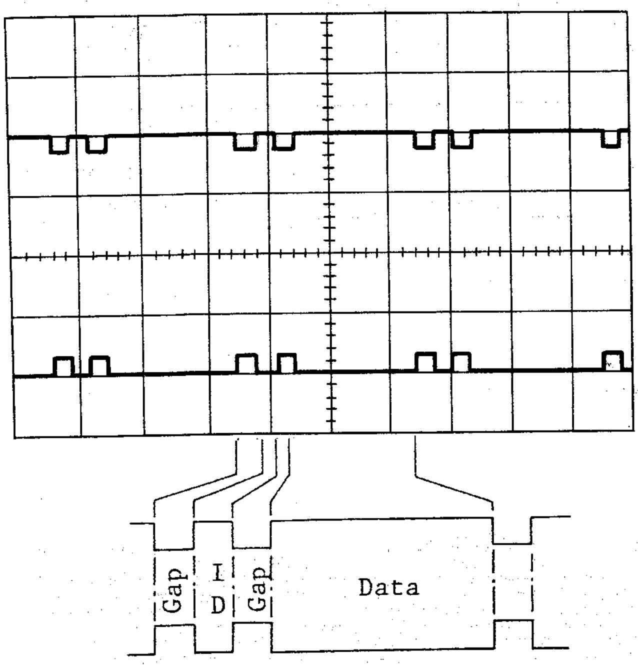


Fig. 5.8

(b) MFM method: Normal waveshape of $(00)_{16}$ track, $(4E)_{16}$ data

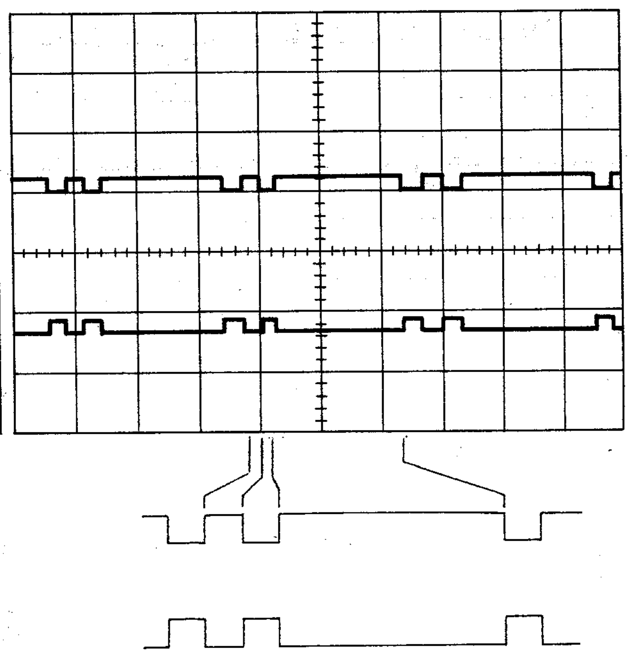


Fig. 5.9

(c) FM method: Normal waveshape of $(00)_{16}$ track, $(00)_{16}$ data

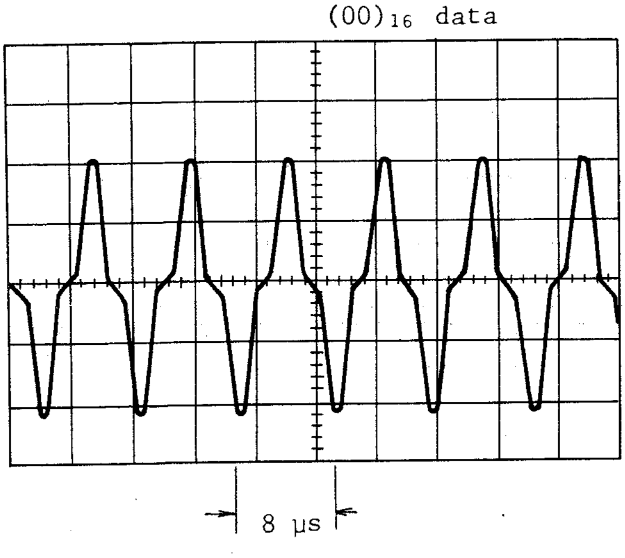


Fig. 5.10

(d) FM method: Normal waveshape of $(4C)_{16}$ track, $(FF)_{16}$ data

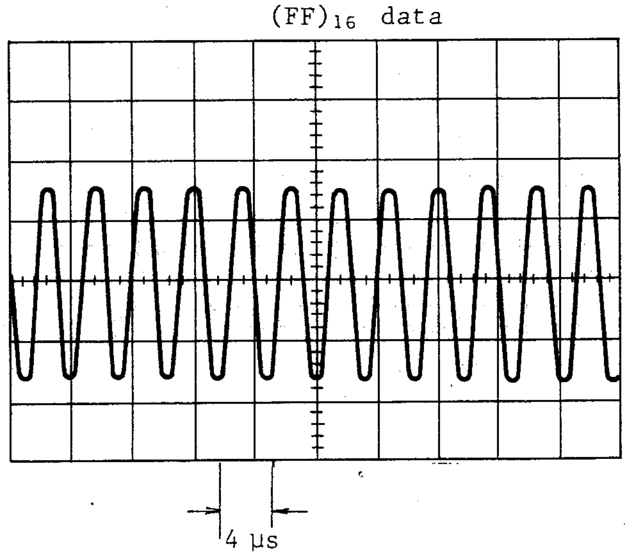


Fig. 5.11

(e) Example of drop-out (damage)

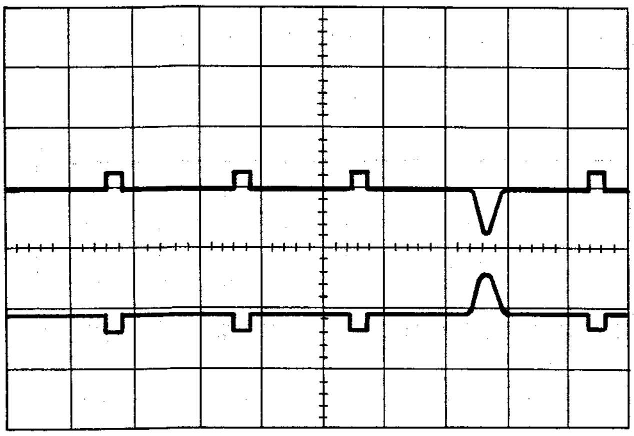


Fig. 5.12

(f) Example of drop-out (damage)

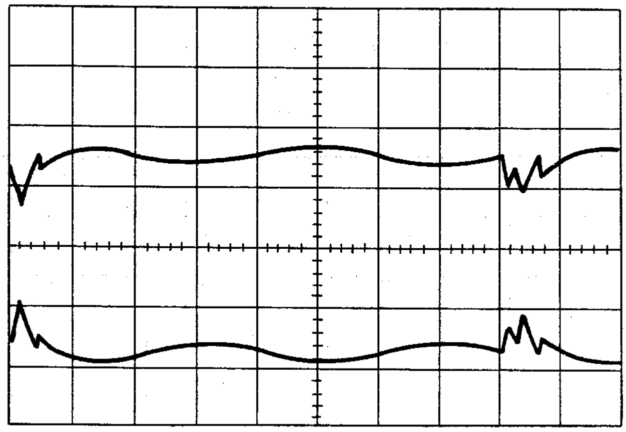


Fig. 5.13

(g) Example of drop-out (damage)

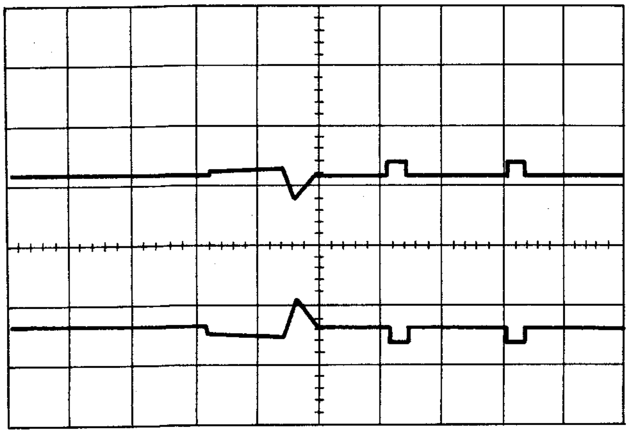


Fig. 5.14

(h) Example of drop-out (fingerprint)

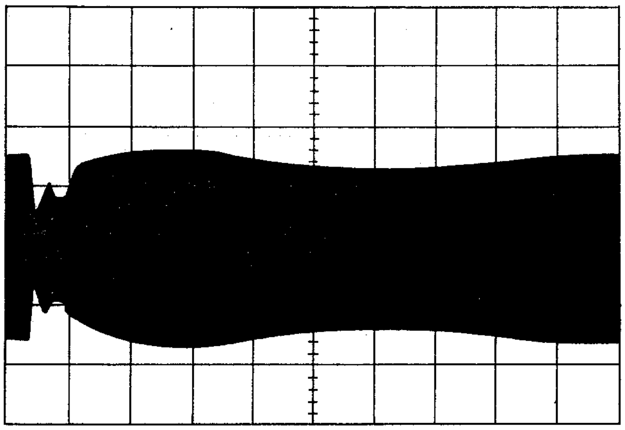


Fig. 5.15

(i) Example of drop-out (demagnetized)

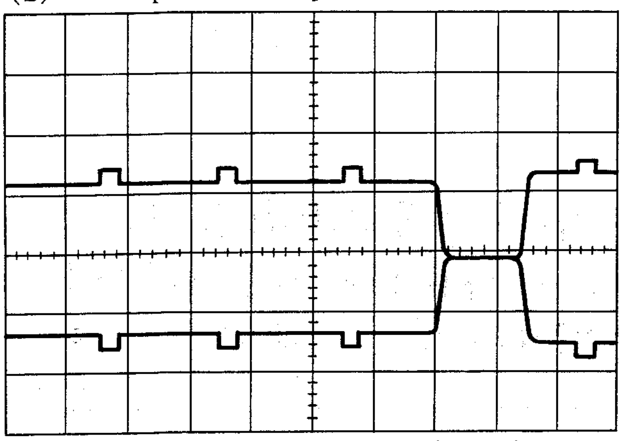


Fig. 5.17 →| |← Relatively long

(j) Example of drop-out (head detached)

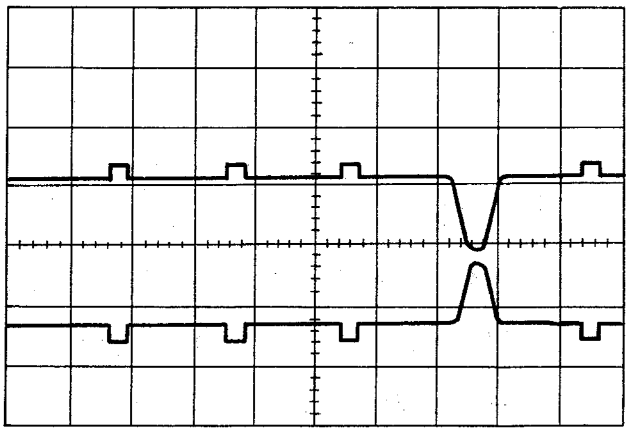
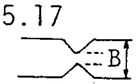


Fig. 5.17



A ... $\frac{B}{A} \leq 0.7$

Table 5.1

Symptom		Probable Cause	Corresponding to Item 5.2.4
Error at the same address over several tracks	Remedied by rewriting	Erasure	III-3
	Not remedied by rewriting	Damage, fingerprint, etc.	I-1, I-2, I-3, I-4
Error on a single track	Remedied by rewriting	Faulty writing	II-1
	Not remedied by rewriting	Bad spot	I-3, I-4

(k) Example of defective envelope (1)

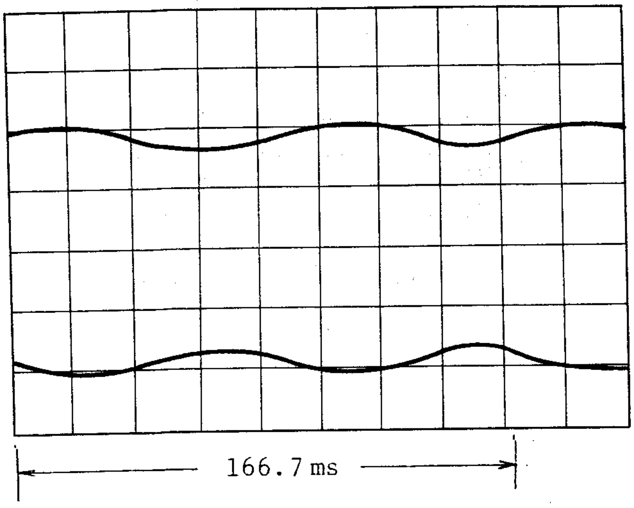


Fig. 5.18

(l) Example of defective envelope (2)

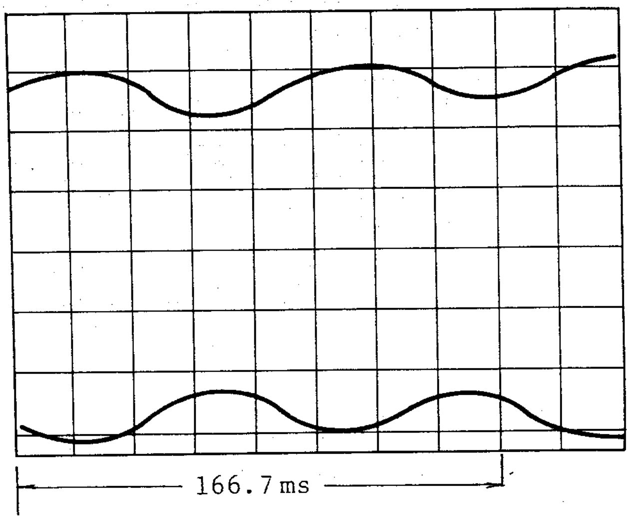
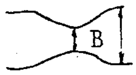


Fig. 5.19



A $\frac{B}{A} \leq 0.7$

Table 5.2

Symptom	Amplitude Variation	Others	Probable Cause	Corresponding to Item 5.2.4
Cyclic	Once per revolution		Eccentricity	I-5, I-6
	Several times per revolution		Changes in speed	Checks on device
Noncyclic	Changes at ramdom		Head detached	II-4
	Changes in fixed area	Remedied by rewriting	Faulty writing	Checks on input device
		Not remedied by rewriting	Dent, etc.	I-1, I-2, I-3, II-1

(m) Example of abnormal data cycle

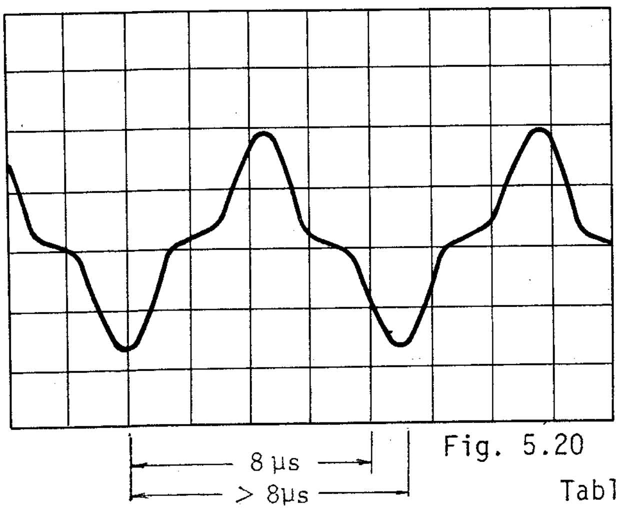


Fig. 5.20

With FM method:
(00.....) A > 8 μs
(01.....) A > 4 μs

With MFM method:
(1010.....) A > 4 μs
(100100...) A > 3 μs
(11.......) A > 2 μs

Table 5.3

	Symptom	Probable Cause	Corresponding to Item 5.2.4
Long data cycle	Same symptom on another system device	Error at writing	II-2, II-3, II-4, III-5
	Normal on another system device	Error at reading	II-2, II-3, II-4, III-5

(n) Example of unsaturated writing, with ID and data parts different in amplitude

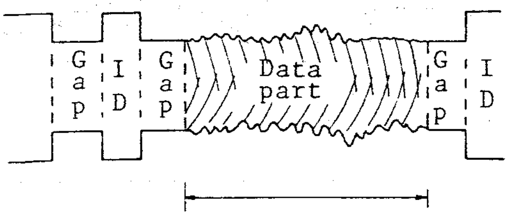
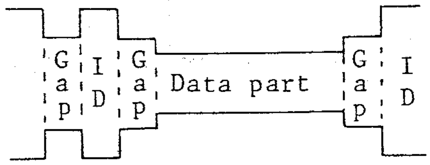


Fig. 5.21

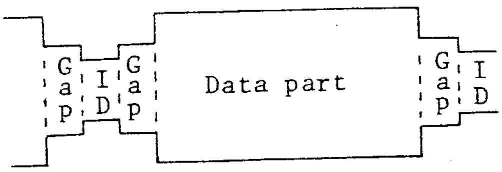
(o) Example of off-track with ID and data parts different in amplitude (1)



Small data part output

Fig. 5.22

(p) Example of off-track writing, with ID and data parts different in amplitude (2)



Small ID part output

Fig. 5.23

(cf) Normal case

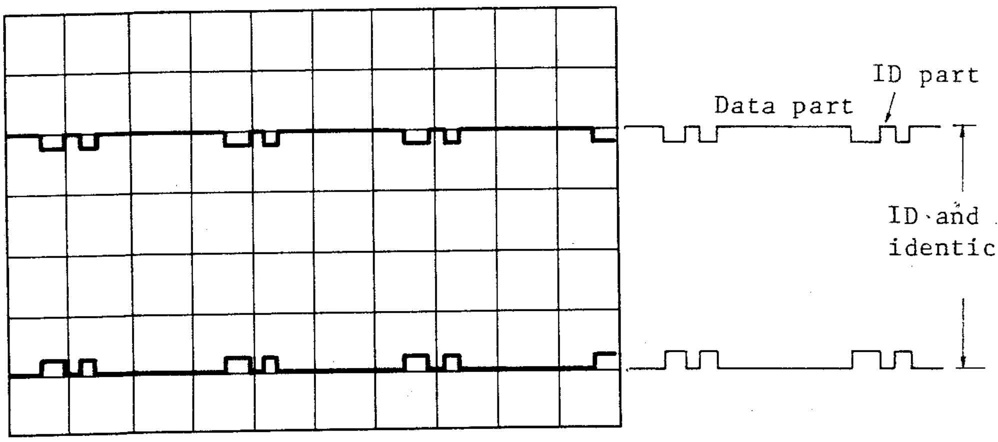


Fig. 5.24

Table 5.4

Symptom			Probable Cause	Corresponding to Item 5.2.4
Data part damaged			Unsaturated recording	I-1,I-2,I-3, II-1
ID and data parts different in amplitude	Small data part		Defective device that wrote data	III-1
	Small ID part	Data written by home device	Home device off tracks	
		Data written by another device	Defective device that wrote data	

(q) Example of abnormal flux change (1)

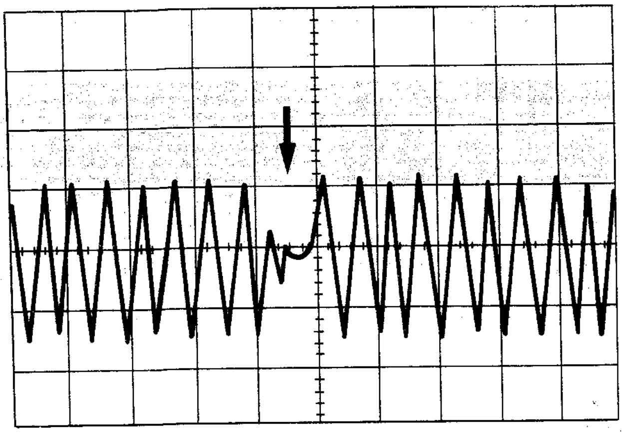


Fig. 5.25

(r) Example of abnormal flux change (2)

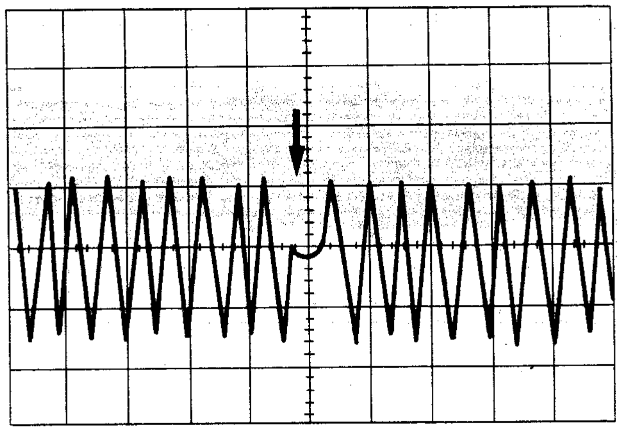


Fig. 5.26

(s) Example of abnormal flux change (3)

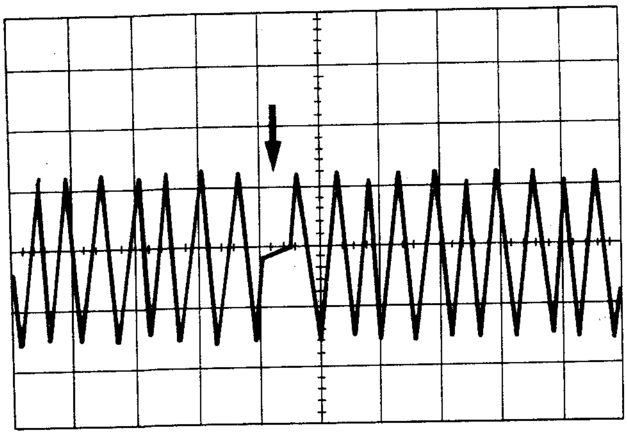
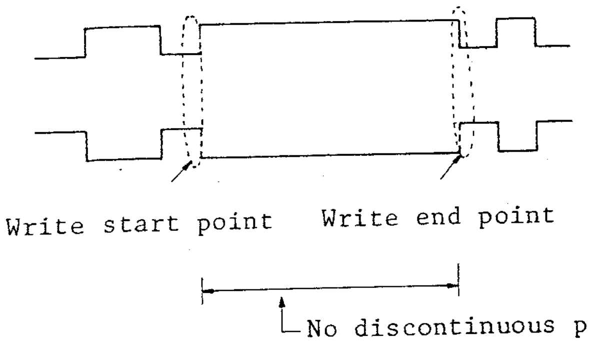


Fig. 5.27



A demagnetized (discontinuous) point at a write start or write end point (see left) is not an error.

Fig. 5.28

Table 5.5

Symptom		Probable Cause	Corresponding to Item 5.2.4
Abnormal flux change in data part	Not remedied by rewriting	Pin hole	I-1
	Remedied by another writing	Noise, etc.	I-1, III-2, III-3, III-4

(t) Noise (carried on data)

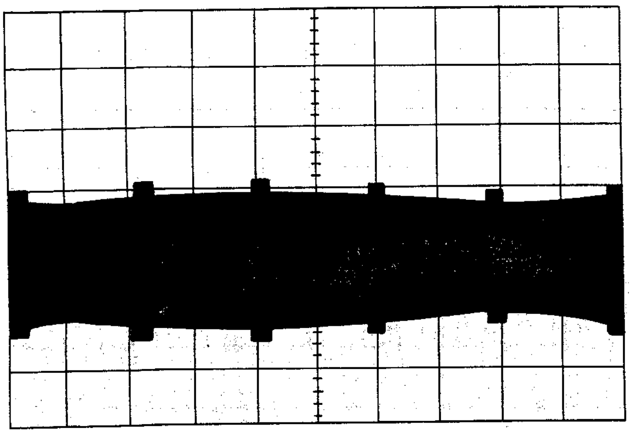


Fig. 5.29

(u) Noise (upon medium removal)

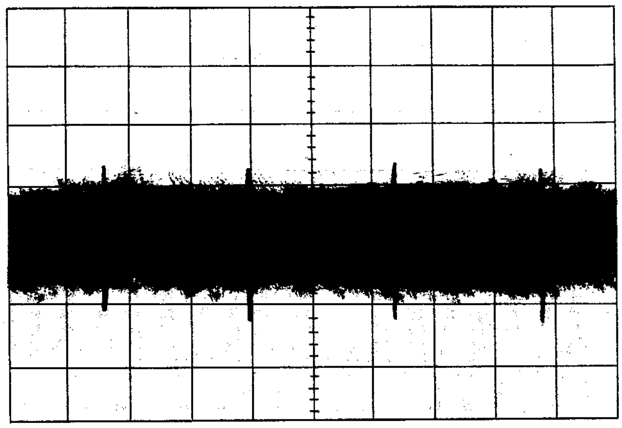


Fig. 5.30

(v) Noise (upon medium removal)

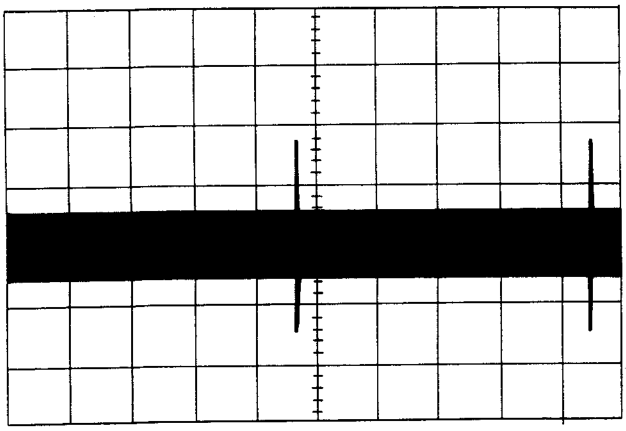


Fig. 5.31

(w) Noise (static electricity noise)

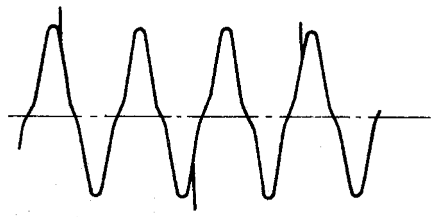


Table 5.6

Symptom			Probable Cause	Corresponding to Item 5.2.4
Cyclic	Error only with medium mounted	Same with other media	Noise within FDD	Chekcs on FDD
		No error with other media	Defective media	Checks on FDD that wrote data
	Error without media	50/60Hz sync	Power supply section defective	Checks on power supply section
		High frequency	External noise	Checks on noise sources
Noncyclic	Error only with medium mounted		Static electricity noise	III-6
	Error without media		Noise within FDD	Chekcs on FDD

5.2.4 Major Floppy Disk Failures

Given below are examples of failures encountered in the field and classified into 18 patterns. The patterns are categorized into three groups by hardware and operation: disk, jacket and read/write status.

The probable causes listed under the "Probable Cause" column are only the causes actually encountered in the field. They do not necessarily apply to all cases.

Table 5.7 (1)

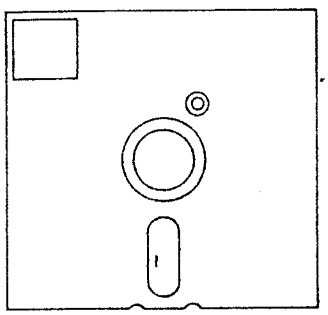
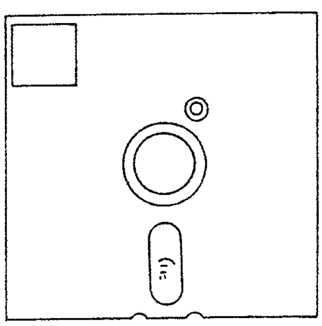
Group		Typical Failure	Probable Cause	Error Sympyom / Remedy
(1) Disk	1	The oxide-coated surface is damaged or dented. 	1. The surface came in contact with pins or the like. 2. Entries were made into the label with a ball-point pen or some writing utensils with a hard tip. 3. The disk was pinched with a clip. 4. Someone leaned on the disk or placed something heavy on it.	1. Read error or write error. — 1. Handle with care. 2. Initialize. (a) Discard the disk if there are 3 or more defective tracks. (b) If there are 2 defective tracks or less, specify these tracks and make another initialization.
	2	There are discolored streaks on the oxide-coated surface. 	1. Fingerprints were deposited. 2. Solevent (alcohol, thinner, etc.) was spilled.	1. Read error or write error. — 1. Handle with care. 2. Discard.

Table 5.7 (2)

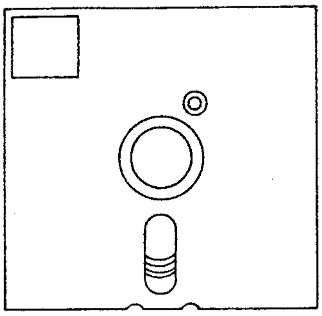
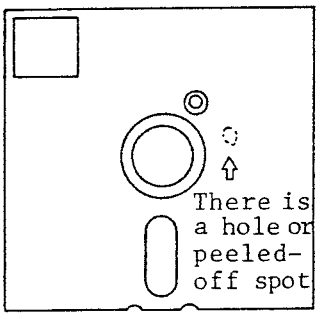
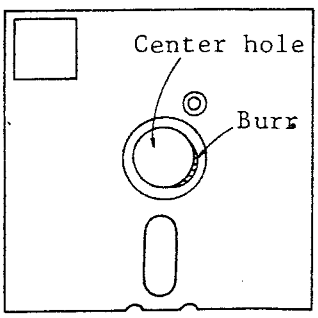
Group		Typical Failure	Probable Cause	Error Symptom	Remedy
(I) Disk	3	Brown impurities are present on the oxide-coated surface (oxide coating damaged). 	1. The service life expired. 2. Storage or operating temperature/humidity requirements were exceeded, with the result that the oxide coating was peeled off and stuck. 3. Impurities that entered between disk and jacket caused the oxide coating to be peeled off and stuck.	1. Read/write error	1. Same as remedy I-1. 2. Observe the storage and/or operating temperature/humidity requirements.
	4	The same periphery as the index hole has a spot that allows light to pass.   Drop-in is detected in an index pulse observation.	1. The product quality is defective; the oxide coating is irregular. 2. The product quality is defective; the oxide coating was peeled off. 3. Impurities entered between disk and jacket and caused the oxide coating to be peeled off and stuck.	1. The device does not enter the ready state. 2. Read errors or write errors become more frequent.	1. Consult the floppy disk manufacturer. Replace or discard the disk.
	5	There are burrs at the center hole edge.  	1. While the FDD was not powered, the floppy disk was inserted and the disk cover closed. 2. In a rare case, this error is attributable to an FDD failure.	1. The disk cover is difficult to open. 2. Read error or write error.	1. Operate with care. 2. Check the FDD collet. 3. Discard the disk.

Table 5.7 (3)

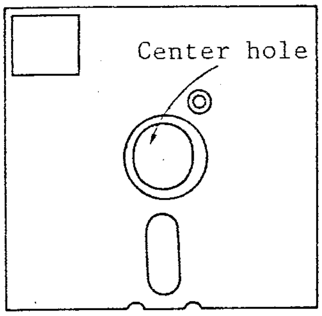
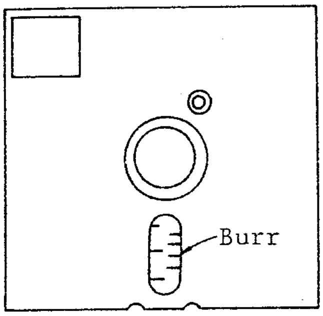
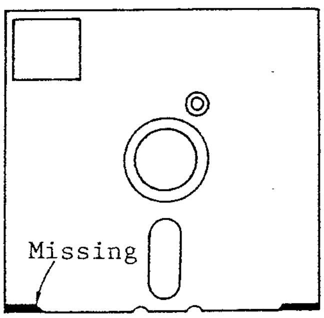
Group		Typical Failure	Probable Cause	Error Sympyom Remedy
(I) Disk	6	The center hole is oval. 	1. The product quality is defective; this defect was left unnoticed upon delivery.	1. Read error or write error.
				1. Consult the floppy disk manufacturer. Replace or discard the disk.
(II) Jacket	1	There are fluffy burrs on the oxide-coated surface. 	1. The product quality is defective; the burrs were present upon delivery or appeared during use.	1. Read/write error or seek error.
				1. Same as remedy I-6.
	2	Both ends at jacket bottom are bit off. 	1. The disk was mounted on the FDD 1500 to 2000 times and reached the end of service life. 2. The disk was roughly mounted on and dismounted from the FDD.	1. Read error or write error. 2. Inadequate feeding or jamming by auto-loader.
				1. Discard. 2. Insert the disk gently into the FDD. 3. Divert to work disks the program disks frequently used.

Table 5.7 (4)

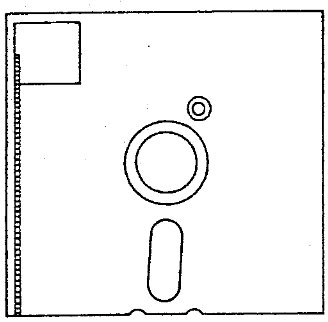
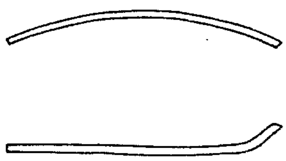
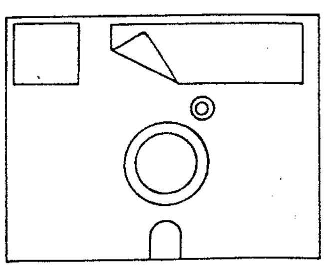
Group		Typical Failure	Probable Cause	Error Symptom	Remedy
(II) Jacket	3	The left end of the jacket is stepped. 	1. The disk was mounted on the FDD 1500 to 2000 times and reached the end of service life.	1. Read error or write error.	1. Discard. 2. Divert to work disks the program disks frequently used.
	4	The jacket is buckeld. 	1. The product quality is defective. 2. Storage or operating temperature/humidity requirements were exceeded. 3. The disk was placed on an irregular surface and was given a pressure.	1. The disk not pop out of the FDD. 2. Inadequate feeding or jamming by auto-loader. 3. Read error or write error.	1. Discard. 2. Observe the storage or operating temperature/humidity requirements. 3. Handle with care.
	5	The jacket is excessive in outside dimensions (W×L×H).	1. The product quality is defective.	1. Same as the error symptom in II-4.	1. Consult the floppy disk manufacturer. Replace or discard the disk.
	6	The label put on the jacket is beginning to peel off. 	1. Defective label. 2. The label was inadequately applied. 3. In a rare case, the peeling-off is attributable to an FDD fault.	1. Same as the error symptom in II-4.	1. Consult the floppy disk manufacturer. Replace or discard the disk. 2. Apply a new label. 3. Check the FDD collet or the path through which to insert the FDD.

Table 5.7 (5)

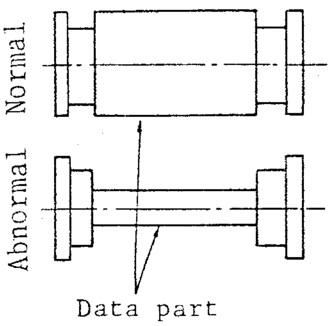
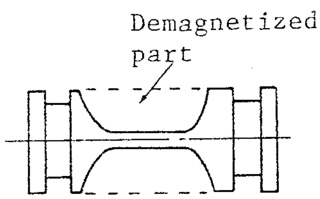
Group		Typical Failure	Probable Cause	Error Symptom	Remedy
(III) Read/write status	1	Error due to read position displacement  	1. The write head is displaced. · If ID parts cannot be read, the initialized device is responsible. · If data parts cannot be read, the entry device is responsible. 2. The read head is displaced. 3. In a rare case, the product quality is defective.	1. Read error or write error.	1. Check the read device or write device. 2. Consult the floppy disk manufacturer. Replace the disk or make another initialization. 3. Perform checks before making initialization.
	2	Error due to write/read function failure	1. Data cannot be written or read out properly due to an FDD failure. 2. The cover was opened or a head load-off was effected during a write operation.	1. Read/write error or seek error.	1. Check the FDD. 2. Handle the FDD cover with care.
	3	Error by demagnetization  	1. Correctly recorded data was destroyed by a magnet (e.g., magnet ring) that came in contact. 2. In a rare case, an FDD failure is responsible for this error.	1. Read error or write error. (Remedied by initialization or write operation)	1. Perform initialization or rewrite operation. 2. Check the FDD.
	4	Error due to faulty write format	1. The write format is not as required (incompatibility with other manufacturers' devices).	1. Read/write error or format error.	1. Perform initialization, or check the data format of the write device.

Table 5.7 (6)

Group		Typical Failure	Probable Cause	Error Symptom / Remedy
(III) Read/write status	5	Different supply voltage setting for read or write device.	1. The supply voltages are different. 2. The supply line voltages are different.	Error Symptom: 1. Read/write error or seek error. Remedy: 1. Check the spindle motor in the write or read device.
	6	Error due to static electricity noise.	1. This error may occur where the jacket, envelope or disk was not subjected to antistatic treatment.	Error Symptom: 1. Read error or write error. Remedy: 1. Consult the floppy disk manufacturer. Replace or discard the disk.

5.3 Medium Management

5.3.1 Necessity of Medium Management

(1) Floppy disk-related errors

Figure 5.32 shows how errors occurred in a device using floppy disks.

As can be seen from the figure, the errors related to floppy disks were on the rise while the device was boosted in reliability. This situation cannot be tolerated.

Figure 5.33 compares read/write errors between work disk and system disk, indicating a disproportionately high frequency of errors on work disks that are more often handled manually than system disks.

Given such a close relationship of floppy disks to read/write errors, however, adequate medium management procedures are yet to be established. Medium management is getting more important as floppy disks are more often used for more data density from now on.

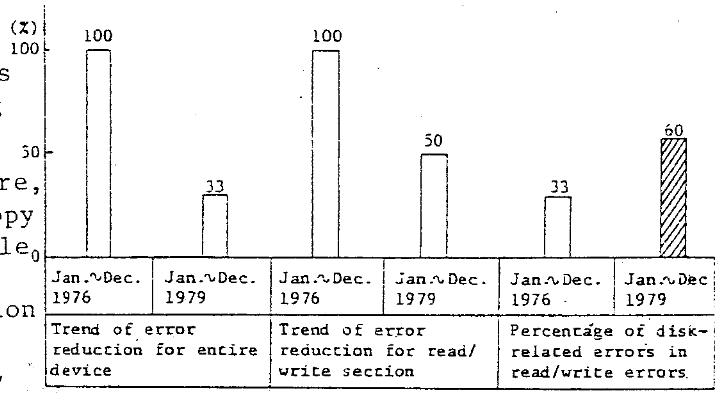


Fig. 5.32 Trends of Error Occurrence

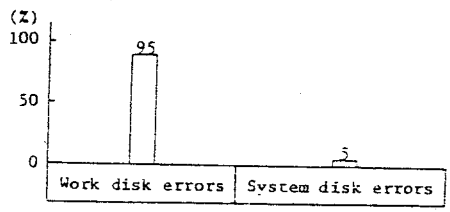


Fig. 5.33 A Comparison of Work Disk Errors with System Disk Errors in Percentage

(2) Loss in system operation

The losses in system operation due to floppy disk-related read/write errors generally fall into the following categories:

(a) Loss of time by reexecution of job (retry, copy into another floppy disk, reentry of all data, etc.)

(b) Delayed output time affecting associated departments and/or end users

(c) Increased recoverable errors resulting in more processing time.

The severity of actual loss will depend on the circumstances:

(a) The error occurring at the busiest transaction time
(b) The error occurring in critical data
(c) The error occurring near the computer output time
(d) The error occurring in a job that shows significant loss when subject to reexecution.

As described above, minimizing losses in system operation requires considerations in every aspect of the business and computing environment.

5.3.2 Medium Life

The medium is held in contact with the magnetic heads during a read/write operation. Since the disk is mounted as needed, the way to handle and store it significantly affects the service life. In addition, the product quality varies from manufacturer to manufacturer.

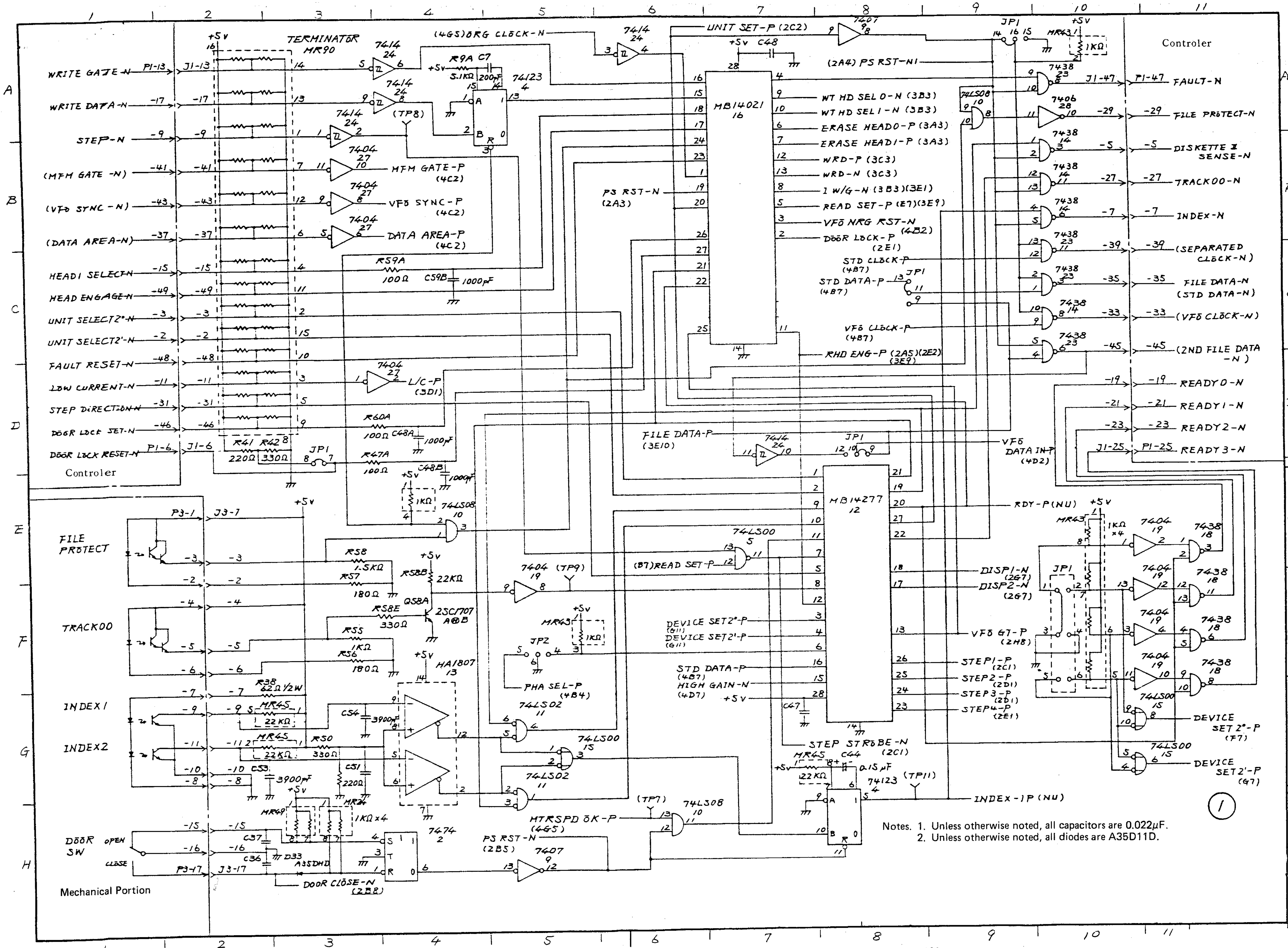
(1) What shortens service life of media

Table 5.8

	Category	Probable Cause Shortening Service Life	Damaged Portion	Remarks
1	Associated with FDD control method	Synchronized and repeated head load/unload operations on the same spot of oxide coating.	Oxide-coating disk surface	This problem depends on the FDD control circuit for solution. (Considered in circuit design).
2		Continuous use in head load-on state	- do -	- do -
3	Associated with FDD installation design	Use at ambient temperature of 50°C or more	- do -	Where the FDD is used in an inadequately ventilated location, any margin providing for temperature rises is exhausted.
4	Associated with how to set medium on FDD	Medium inserted without FDD spindle rotating	Disk center hole	The disk center hole tends to be damaged, causing an off-track state.
5		Medium left inserted halfway for a long time, with spindle rotating	Jacket	Spindle revolutions damage the jacket.
6		Door closed, with medium inserted halfway into FDD	Jacket and area around disk center hole	Pressure on the collet damages the area around the center hole
7	Associated with how to handle medium	Fingerprints on oxide-coated disk surface	Oxide-coated disk surface	Chemical ingredients at fingerprints change the oxide coating.
8		Use of solvent (thinner, alcohol, Freon, etc.)	- do -	Chemical change on oxide-coating
9		Use of clips	Jacket and disk	The portion pinched by a clip is mechanically deformed, causing an error.
10		Writing on index with pencil, ball-point pen or any hard tip writing utensil	Oxide-coating disk surface	Use of a felt-tip pen (or any soft tip writing utensil) is preferred.
11		Bend or breakage	- do -	Damages causes errors.
12		Use of erasure	- do -	Rubber chips result in error.

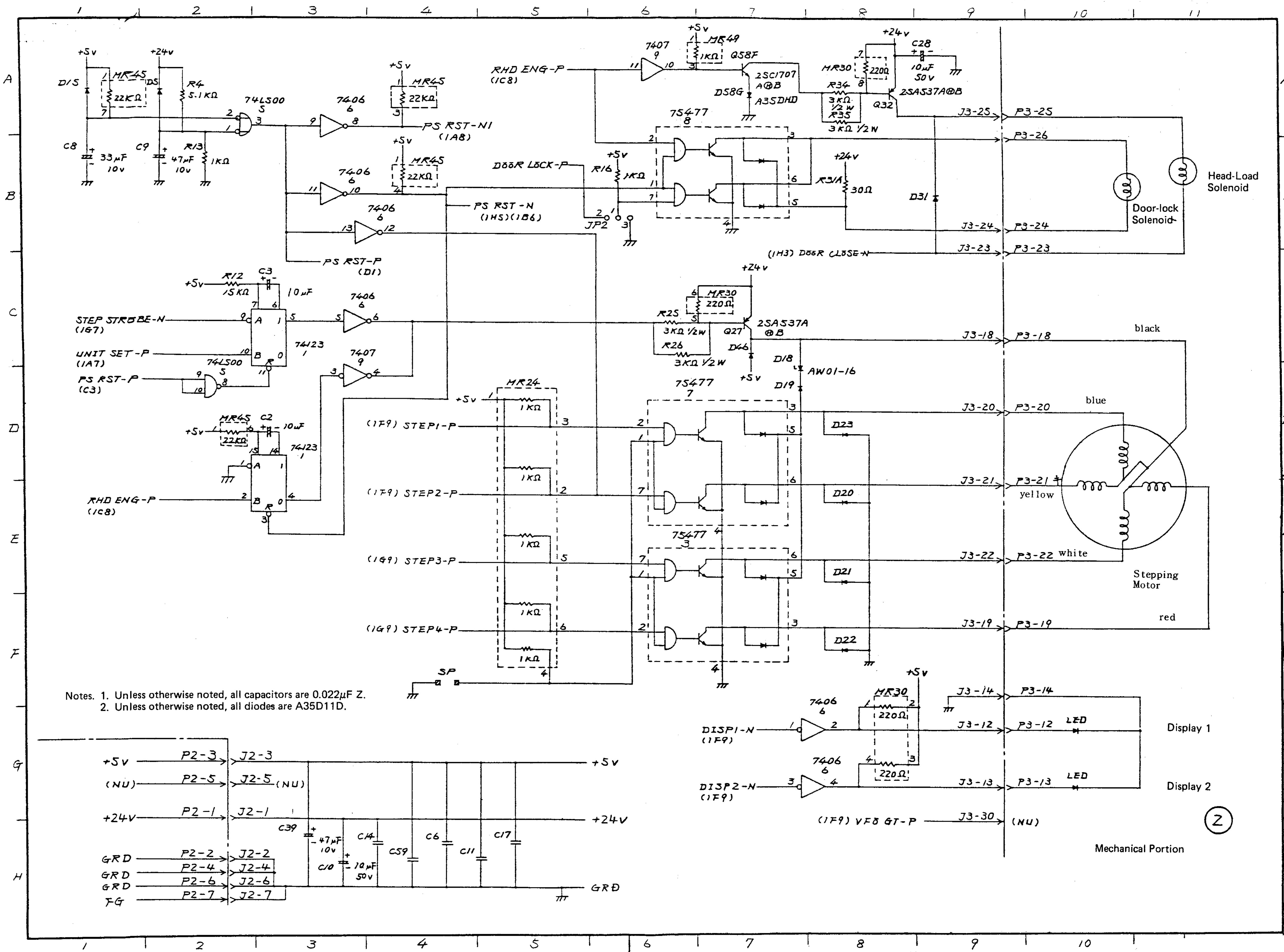
6. CONTROL BOARD

6-1 CONTROL BOARD SCHEMATIC DRAWINGS-1



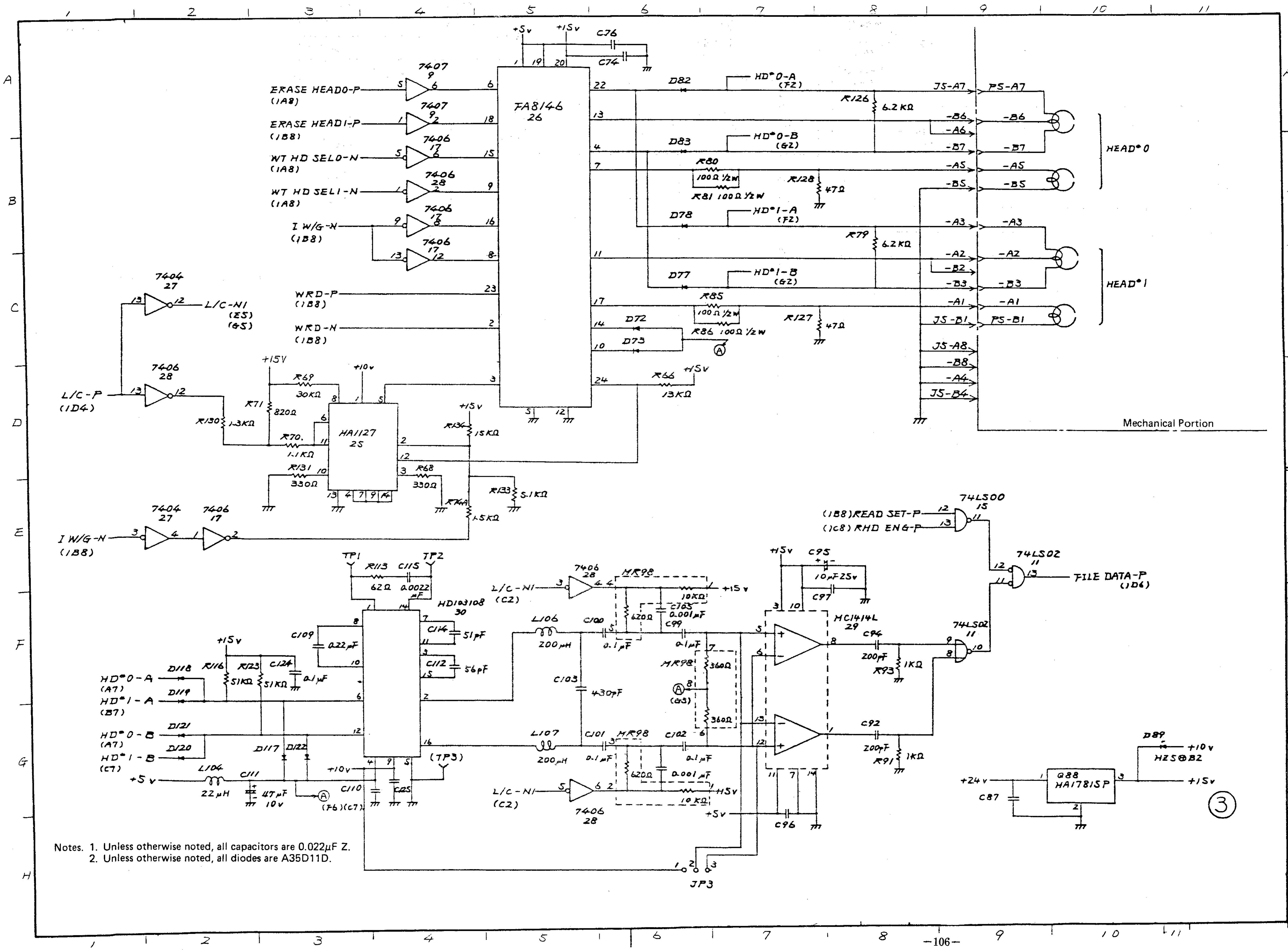
Notes. 1. Unless otherwise noted, all capacitors are 0.022μF.
2. Unless otherwise noted, all diodes are A35D11D.

6-2 CONTROL BOARD SCHEMATIC DRAWINGS-2



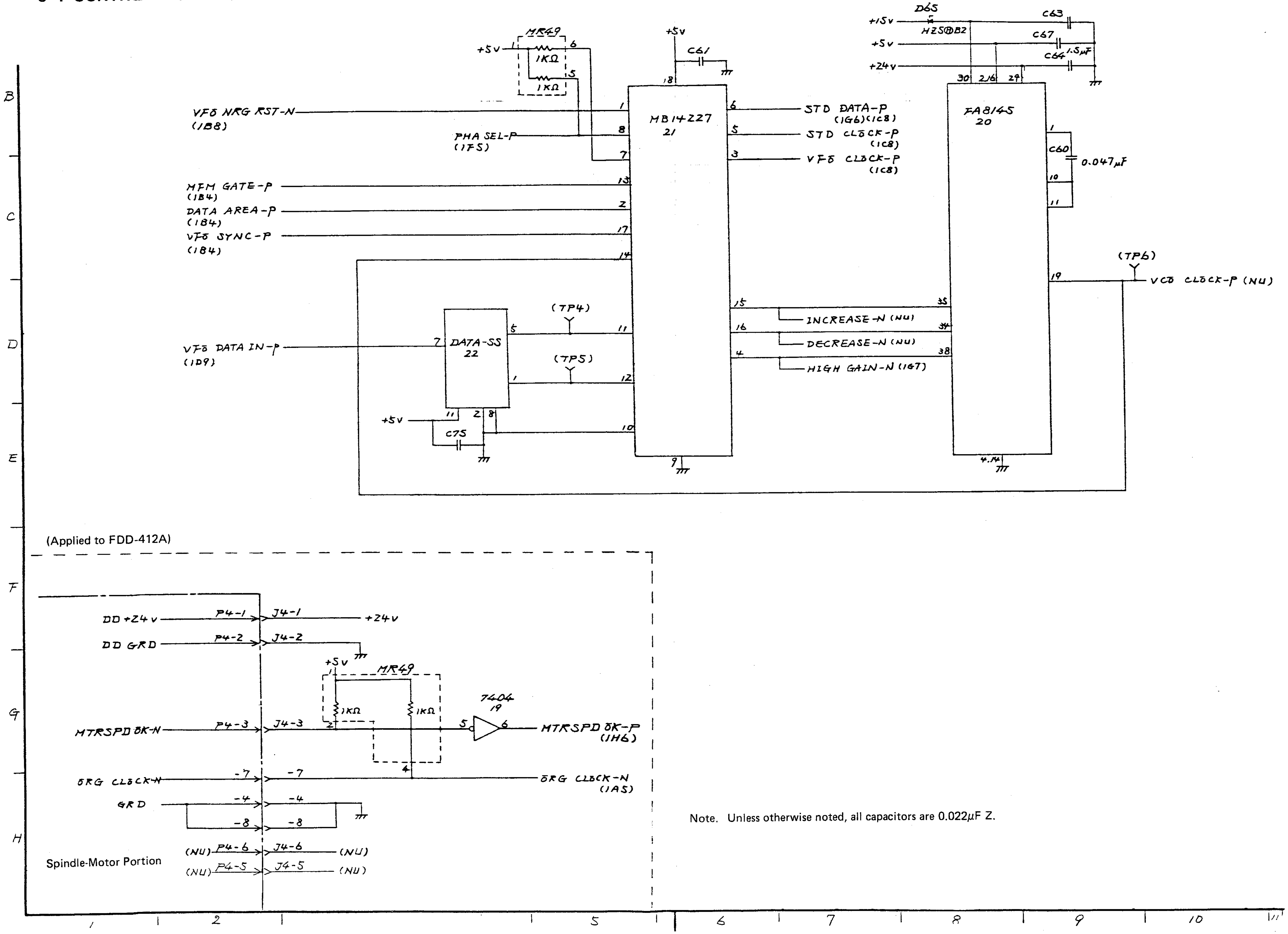
Notes. 1. Unless otherwise noted, all capacitors are 0.022μF Z.
2. Unless otherwise noted, all diodes are A35D11D.

6-3 CONTROL BOARD SCHEMATIC DRAWINGS-3



Notes. 1. Unless otherwise noted, all capacitors are 0.022μF Z.
2. Unless otherwise noted, all diodes are A35D11D.

6-4 CONTROL BOARD SCHEMATIC DRAWINGS-4



Note. Unless otherwise noted, all capacitors are 0.022μF Z.

4

6-5 FDD-412 A/B OPERATING MODE SETUP METHOD

Operation mode of the FDD-412A/B must be set according to the following procedures using jumper plug and terminator.

1. Terminator

   Terminator consists of the MR90 and jumper connector JP1 (7-8).

	MR90	JP1 (7-8)
Used (Yes)	Mount on the IC socket.	Must be connected.
Not used (No)	Remove from the IC socket.	Remove.

   NOTE: JP1 (7-8) is the terinator for the DOOR LOCK RESET-N signal.

2. Address setup

   Set the jumper plug to the specific position of the jumper connector JP1 according to the FDD unit No.

	JP1	Figure
FDD #0	Short between 1 and 3.	Fig.1-(a)
FDD #1	Short between 2 and 4.	Fig.1-(b)
FDD #2	Short between 3 and 5.	Fig.1-(c)
FDD #3	Short between 4 and 6.	Fig.1-(d)

3. Daisy chain connection

   Set the jumper plug to the given position in reference with the table below according to the desired daisy chain configuration.

Mode	Refer to	JP1 connections			Figure	Note
1	Fig.2-(a)	9-10	11-13	14-16	Fig.3-(a)	1
2	Fig.2-(b)	10-12	11-13		Fig.3-(b)	2
3	Fig.2-(c)	15-16			Fig.3-(c)	2
4	Fig.2-(d)	9-11	14-16		Fig.3-(d)	3

NOTE-1:

Data separation is carried out independently for each FDD by means of the VFO circuit of each FDD.

NOTE-2:

Only one model A (w/VFO) should reside within the same daisy chain.

NOTE-3:

Data separation is not one in the FDD. It needs implementation of the VFO circuit in the FDC.

4. Use of the model A as the model B

   It is possible to use the model A FDD (w/VFO) as the model B FDD (w/o VFO) by changing the jumper plug connection as shwon below.

JP1 position	---	11-13	⇨	9-11
Function	---	Model A		Model B

5. Changing VFO clock phase

Set to the desired phase method according to the list below, using jumper wire.

	JP-2
A method	Open between 5 and 6.
B method	Short between 5 and 6.

NOTE: For the detail of A and B methods, refer to Instruction Manual of the device.

6. Changing door lock mode

Set to the desired door lock mode according to the lit below, using jumper plug.

JP-2 position	Operational mode
Short between 1 and 3.	Door can be locked only by the HEAD ENGAGE signal.
Short between 1 and 2.	Door can be locked by either DOOR LOCK or HEAD ENGAGE signals.

7. Test points

The following signal names are used for test points (TP).

TP No.	Signal name
1	Read signal
2	Read signal
3	DC GRD
4	DATA SS (1uS)-1P
5	DATA SS (0.5uS)-1P
6	VCO CLOCK-P
8	STEP-P
9	TRACK 00-P
10	INDEX-1P

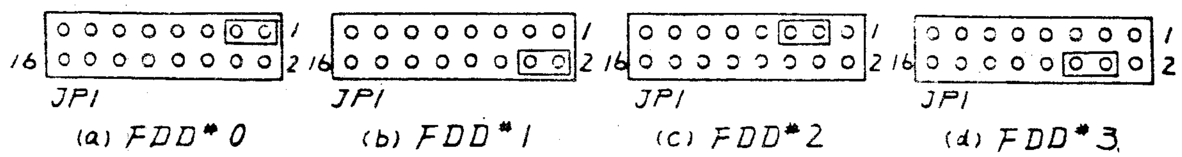


Fig.1 Address setup

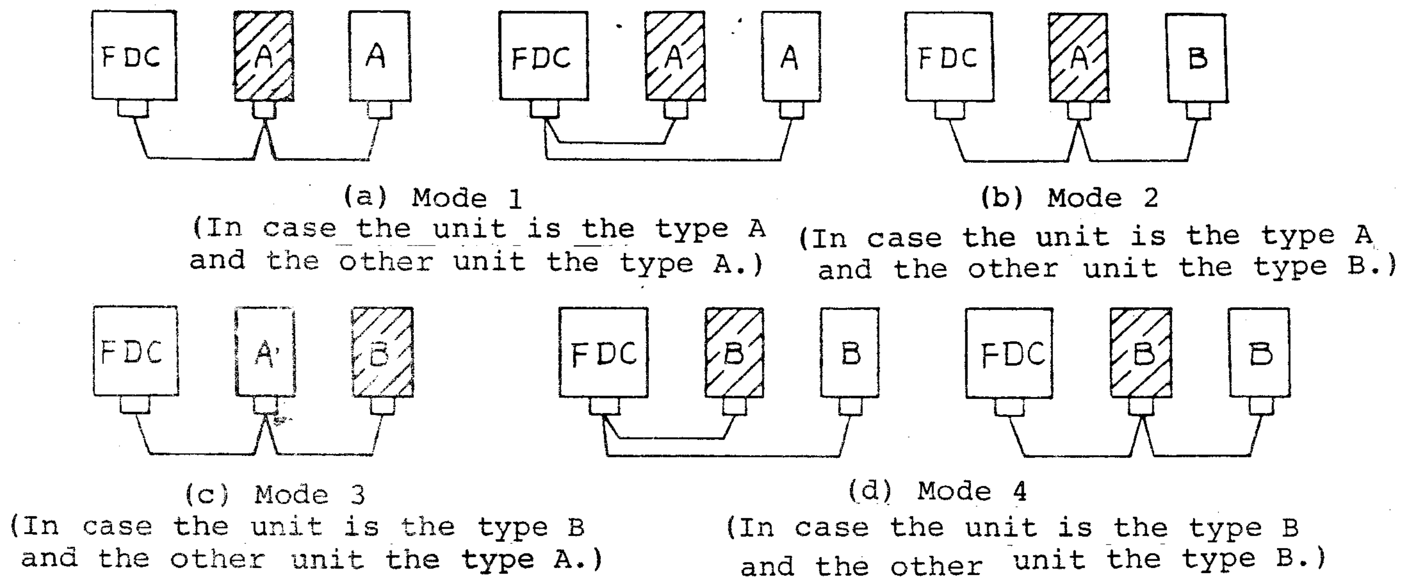


Fig.2 Daisy chain configuration mode select

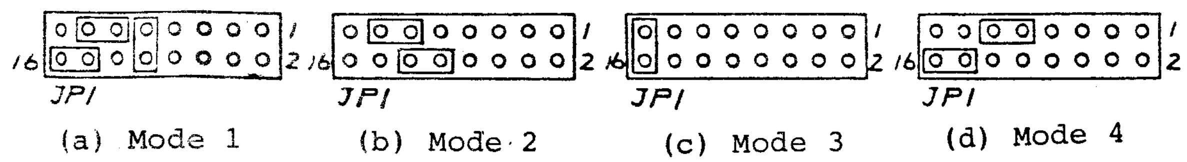
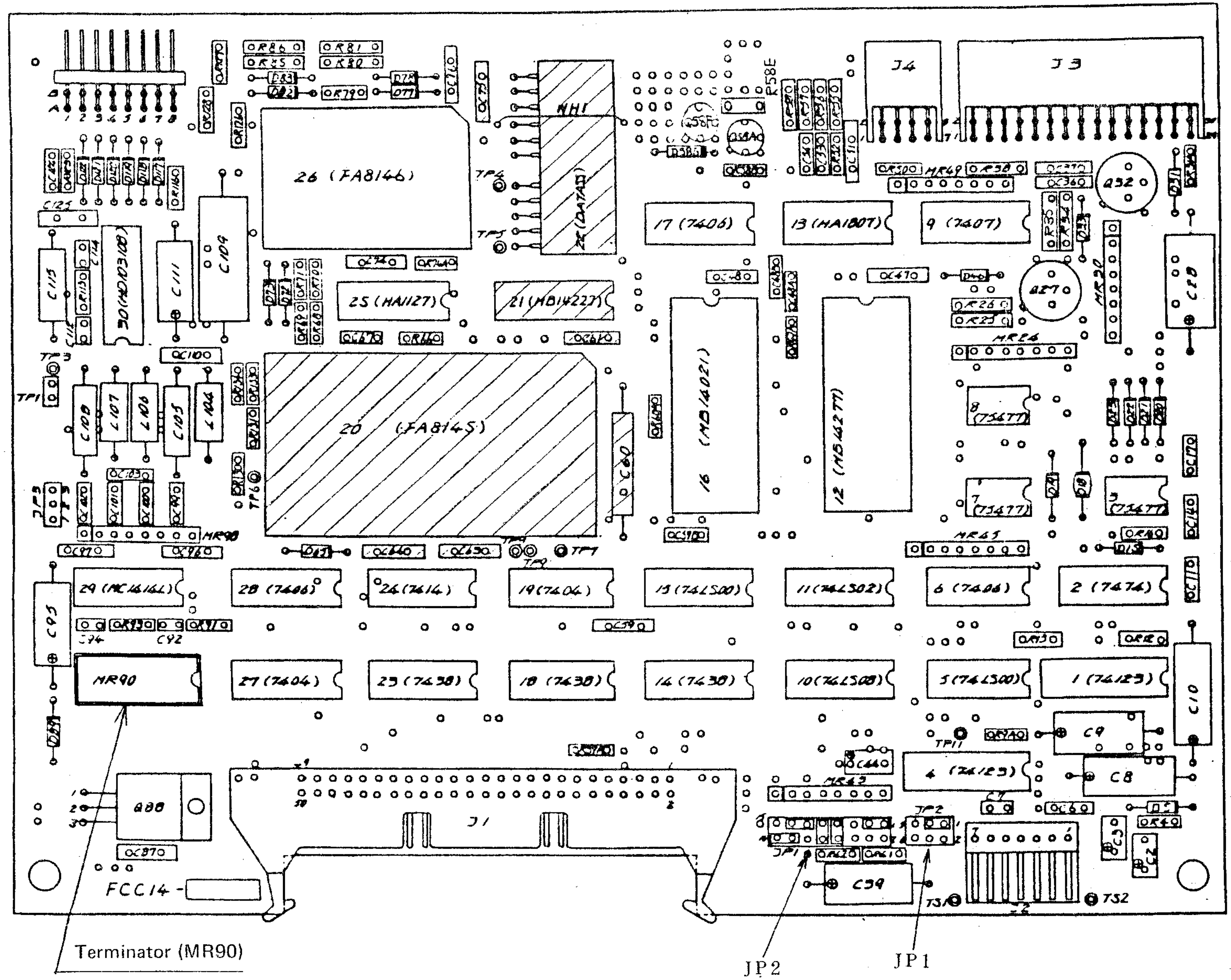


Fig.3 Daisy chain mode setup chart

6-6 PARTS LAYOUT CHART

FDD412 Parts layout chart

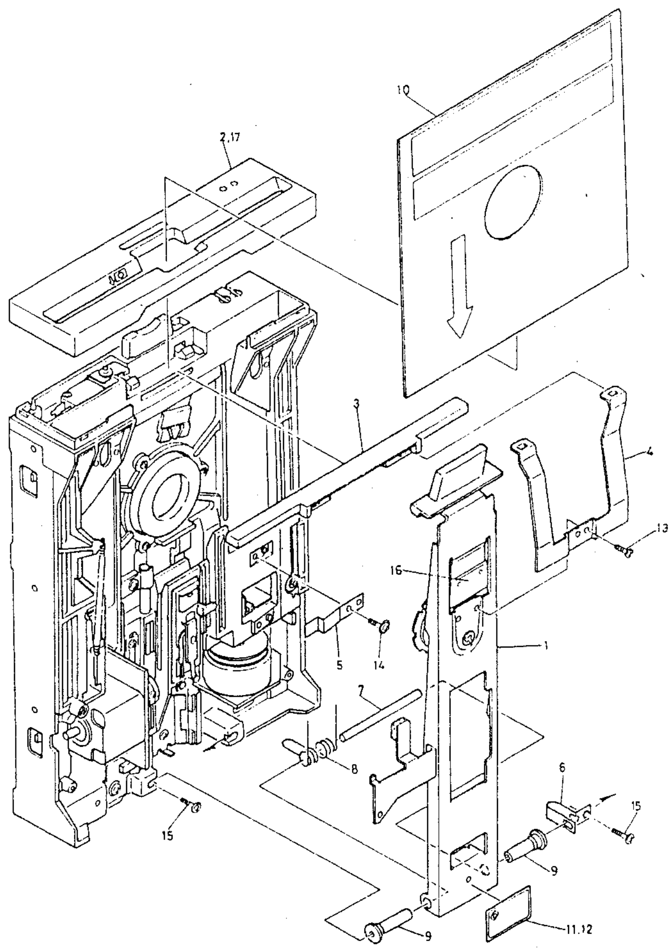


Others
1) Do not affix the jumper plug to the JP3.
2) Items in shadowed portions are not implemented for the model B.

7. PARTS LIST & GUIDE

1. FDD412 FINAL ASSY (1/3)

NO.	PARTS CODE	PRICE RANK Ja.	PRICE RANK Ex.	NEW MARK	PARTS RANK	DESCRIPTION	
1	DUNTK3010SCZZ	**	**	N	E	FDD-412AファイナルASSY	FDD-412A Final assy
	DUNTK3011SCZZ	**	**	N	E	FDD-412BファイナルASSY	FDD-412B Final assy
1- 1	——————	—	—			プレートASSY	Plate assy (See list 2)
1- 2	0AP2069908—1/	M C	B P	N	D	トップカバー412	Top cover 412
1- 3	0AP2069906—1/	L M	B M	N	C	カバー (モールド)	Cover (Mold)
1- 4	0AP3198054—1/	E X	A R	N	C	イタバネ (カバー)	Spring (Cover)
1- 5	0AP5434582—2/	E C	A L	N	C	スプリング (ベイル)	Spring (Ball)
1- 6	0AP5434575—1/	E C	A L	N	C	スプリング (プレート)	Spring (Plate)
1- 7	0AP5434566—1/	F T	A W	N	C	シャフト (プレート)	Shaft (Plate)
1- 8	0AP3198061—1/	E X	A R	N	C	ドアスプリング	Door spring
1- 9	0AP5434564—1/	E H	A N	N	C	ブッシュ (プレート)	Bush (Plate)
1-10	0AP5426532—2/	E H	A N		C	ホゴシートA	Preserve sheet
1-11	0AP3198072—1/	E C	A L	N	C	ネームプレート FDD412A	Name plate FDD412A
1-12	0AP3198072—2/	E C	A L	N	C	ネームプレート FDD412B	Name plate FDD412B
1-13	0APSB305/////	E C	A L	N	C	ハイネM3×0.5×5	Binding screw M3×0.5×5
1-14	0AP3193781310	E C	A L		C	タッピンネジ	Tapping screw
1-15	0APSB410/////	E C	A L	N	C	ハイネM4×0.7×10	Binding screw M4×0.7×10
1-16	0AP3198091—A/	U E	C C	N	B	インデックスLED ASSY	Index LED assy



2. FDD412 FINAL ASSY (2/3)

NO.	PARTS CODE	PRICE RANK Ja.	PRICE RANK Ex.	NEW MARK	PARTS RANK	DESCRIPTION	
1-21	————————	—	—				
1-22	OAP5434578–1/	E R	A Q	N	C	ローラ (ソレノイド)	Roller (Solenoide)
1-23	OAP2070509–A/	* *	* *	N	B	FPH 680T ASSY	FPH 680T Assy
1-24	OAP3198076–A/	U X	* *	N	B	ステップモータフセンASSY	Step motor assy
1-25	OAP5434559–1/	F U	A W	N	C	シャフト (ガイド)	Shaft (Guide)
1-26	OAP5434559–2/	F U	A W	N	C	シャフト (ガイド)	Shaft (Guide)
1-27	OAP5434588–1/	F U	A W	N	C	プレート (ガイドバー) 1	Plate (Guide bar) 1
1-28	OAP5434560–1/	F U	A W	N	C	プレート (ガイドバー) 2	Plate (Guide bar) 2
1-29	OAP3198053–1/	F L	A U	N	C	スチールベルト	Steel belt
1-30	OAP5427343–1/	G K	B A		C	クランプ (ベルト1)	Clamp (Belt-1)
1-31	OAP5427344–1/	G V	B A		C	クランプ (プーリ)	Clamp (Pulley)
1-32	OAP5434637–1/	F U	A X	N	C	プレート (0センサ)	Plate (0 Senesr)
1-33	OAP3198062–1/	F Z	A Y	N	C	サポート (W/Pセンサ)	Support (W/P Senser)
1-34	OAP5434583–2/	E C	A L	N	C	ストッパ (ヘッドロード)	Stopper (Head load)
1-35	OAP3198058–1/	E R	A Q	N	B	センサブロック	Senser block
1-36	OAPSB408/////	E C	A L		C	バイネM4×0.7×8	Binding screw M4×0.7×8
1-37	OAPSB306/////	E C	A L	N	C	バイネM3×0.5×6.3	Binding screw M3×0.5×6.3
1-38	OAPSB706/////	E C	A L	N	C	バイネM2.5×6.3	Binding screw M2.5×6.3
1-39	OAPSB204/////	E C	A L		C	バイネM2×4	Binding screw M2×4
1-40	OAP2051001413	E C	A L	N	C	LLワッシャ	LL Plain washre
1-41	OAP5405320–1/	E C	A L	N	C	タバセンドメ	Cable clamp
1-42	OAP5414517–1/	E R	A Q	N	C	BUSH	Bush
1-43	OAP3198077–A/	* *	C A	N	B	ヘッドロードASSY	Head load assy
1-44	OAP5434641–A/	L J	B M	N	C	ベイルASSY	Bail assy
1-45	————————	—	—			モールド (バイル) (44に含む)	Mold (Bail) (Included in No. 44)
1-46	————————	—	—			FOAM (44に含む)	Foam (Included in No. 44)
1-47	OAP3198059–1/	E X	A R	N	C	イジェクタ	Ejecter
1-48	OAP5416821–1/	E C	A L		C	テンションスプリング	Tension spring (Ejecter)
1-49	OAPSB425/////	E C	A L	N	C	バイネM4×0.7×25	Binding screw M4×0.7×25
1-50	OAP2051001432	E C	A L	N	C	LLワッシャ	LL Plain washre
1-51	OAP5434613–1/	E C	A L	N	C	ダンパ (プレート)	Damp (Plate)
1-52	OAP3198090–A/	U F	C C	N	B	インデックスASSY	Index assy
1-53	OAP3198094–A/	U C	C B	N	B	ファイルプロテクトASSY	File protect assy
1-54	OAP3198093–A/	U C	C B	N	B	0センサASSY	0 Senser assy
1-55	OAP5434563–1/	F U	A X	N	C	シャフト (ベイル)	Shaft (Bail)

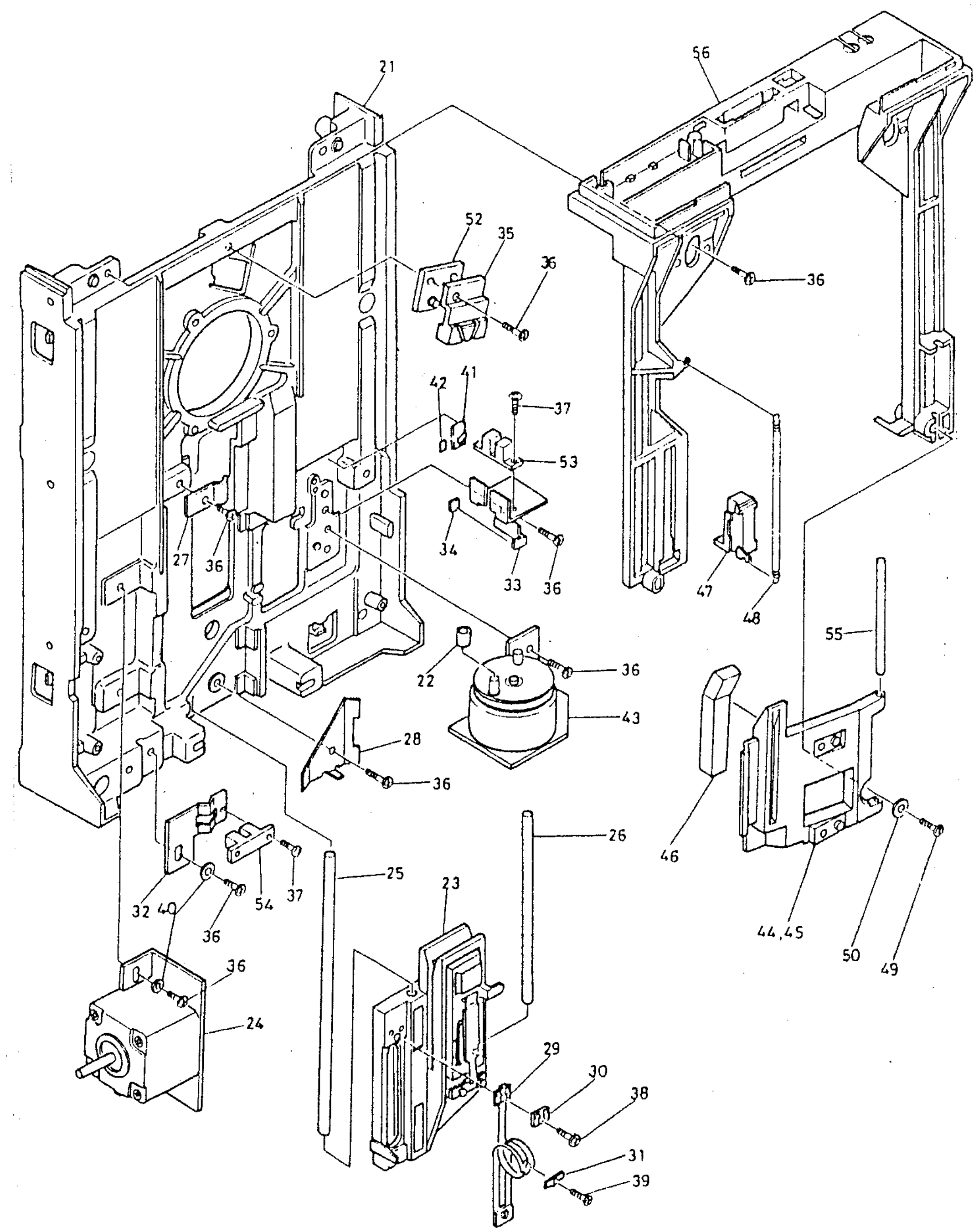
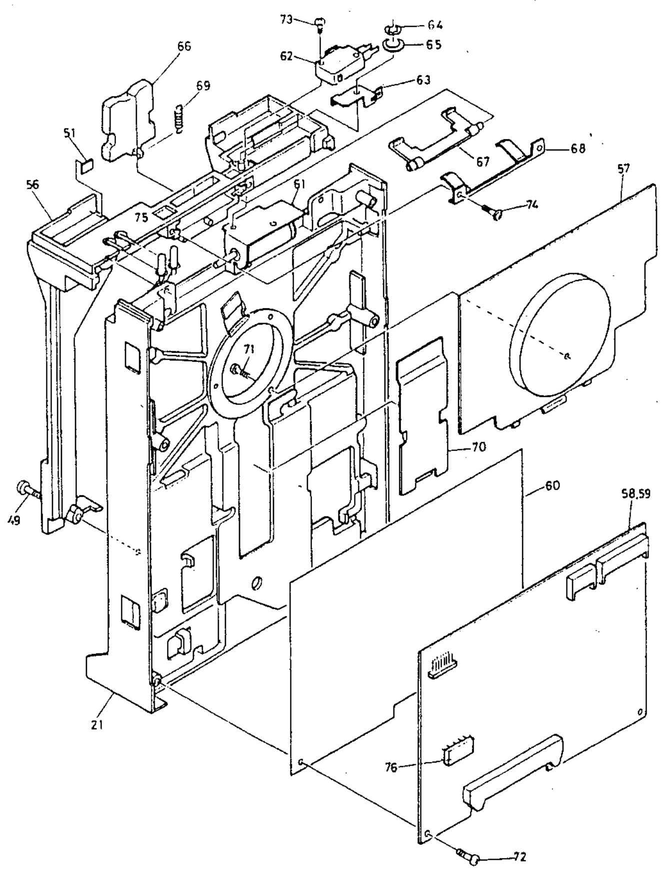


FIG.1 FDD-412 FINAL ASSY (2/3)

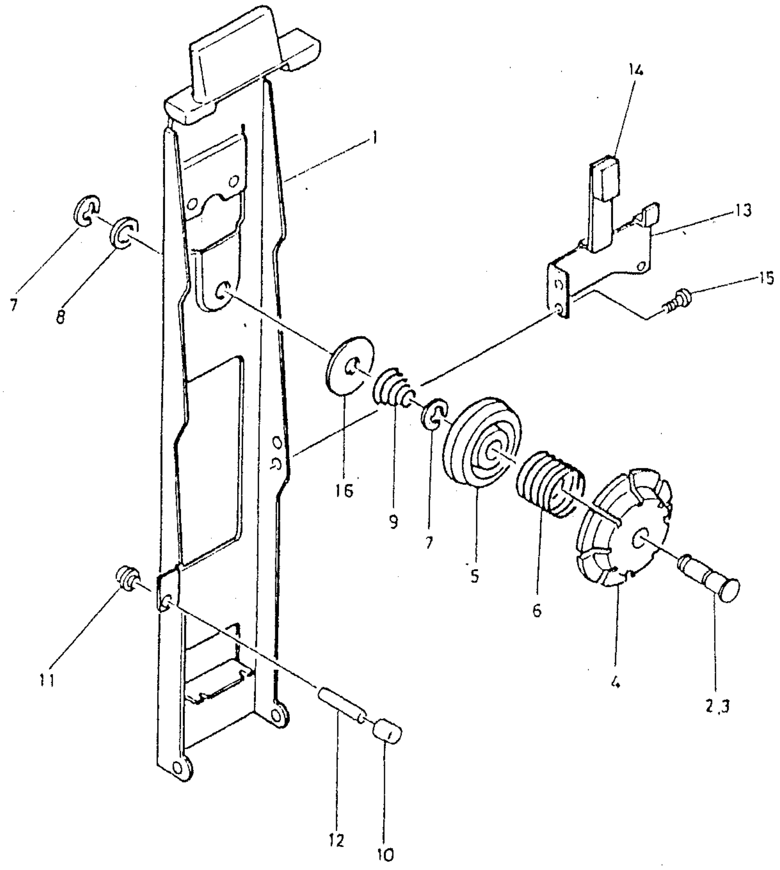
3. FDD412 FINAL ASSY (3/3)

NO.	PARTS CODE	PRICE RANK Ja.	PRICE RANK Ex.	NEW MARK	PARTS RANK	DESCRIPTION	
1-56	0AP188213-1//	N U	B T	N	C	ガイド (モールド)	Guide mold
1-57	0AP3198069-A/	U X	* *	N	E	ASSY (DDM)	DDM Assy
1-58	0AP188209-A//	* *	* *	N	E	FCC14 P/K ASSY	FCC14 P/K Assy FDD-412A
1-59	0AP188209-B//	* *	* *	N	E	FCC14 P/K ASSY	FCC14 P/K Assy FDD-412B
1-60	0AP5434607-1/	F P	A V	N	C	ゼツエンシ (P/K)	Insulator (P/K)
1-61	0AP5434616-A/	N H	B S	N	C	ドアロックASSY	Door lock assy
1-62	0AP3161232-11	F L	A U		B	マイクロスイッチ	Microswitch
1-63	0AP5434586-1/	E X	A R	N	C	アーム (マイクロSW)	Arm (Micro switch)
1-64	0AP5432207-2/	E C	A L	N	C	トメワ (プレート)	Retaining ring (Plate)
1-65	0APWP004/////	E C	A L		C	ワM4	Plain washre M4
1-66	0AP3198060-1/	E X	A R	N	C	ボタン	Button
1-67	0AP3198056-1/	E X	A R	N	C	モールド (ラッチ)	Mold (Latch)
1-68	0AP5434601-1/	E X	A R	N	C	ラッチスプリング	Latch spring
1-69	0APMT065/////	E C	A L	N	C	Tスプリング	Tension spring
1-70	0AP5434603-1/	E X	A R	N	C	シールド (リバース)	Sealed (Reverse)
1-71	0APSB412B////	E C	A L	N	C	BバイネM4×0.7×12.5	B-Binding screw M4×0.7×12.5
1-72	0APSB408/////	E C	A L		C	バイネM4×0.7×8	Binding screw M4×0.7×8
1-73	0APSB320/////	E C	A L	N	C	バイネM3×0.5×20	Binding screw M3×0.5×20
1-74	0AP3193781310	E C	A L		C	タッピンネジ	Tapping screw
1-75	0AP3198092-A/	T Z	C A	N	B	インジケータASSY	Indicater assy
1-76	0AP5427440-1/	F Z	A Y	N	C	ターミネータASSY	Terminater assy



4. PLATE ASSY

NO.	PARTS CODE	PRICE RANK Ja.	PRICE RANK Ex.	NEW MARK	PARTS RANK	DESCRIPTION	
2- 1	OAP2069922-A/	T J	B X	N	C	プレートASM	Plate ASM
2- 2	OAP3198095-A/	R H	B U	N	E	センターコーン ASSY	Center corn assy
2- 3	OAP5434557-1/	L M	B M	N	C	シャフト (コーン)	Shaft (Corn)
2- 4	OAP3198045-1/	H W	B K	N	C	コレット	Collate
2- 5	OAP3198046-1/	H E	B F	N	B	コーン412	Corn 412
2- 6	OAP5434558-1/	E R	A Q	N	C	C-スプリング (コレット)	Compression spring (Collate)
2- 7	OAPTW005/////	D D	A L		C	Eトメク-5	E-Retaining ring
2- 8	OAP5395856-5/	E C	A L		C	プラスチックワッシャ	Plastic washer
2- 9	OAP5434589-1/	E R	A Q	N	C	コレットスプリング	Collate spring
2-10	OAP5434605-1/	E C	A L	N	C	ストッパ (ベイル)	Stopper (Ball)
2-11	OAP5405281-1/	E C	A L	N	C	クリンチナット	Clinch nut
2-12	OAP5434618-1/	E C	A L	N	C	トメネM3×0.5×16	Set screw M3×0.5×16
2-13	OAP3198080-1/	F T	A W	N	C	イジェクトアーム	Eject ARM
2-14	OAP5398217-8/	E C	A L	N	C	FŌAM	Foam
2-15	OAPSB305/////	E C	A L	N	C	バイネM3×0.5×5	Binding screw M3×0.5×5
2-16	OAP5434573-1/	E R	A Q	N	C	ワッシャ (コレット)	Washer (Collate)



NO.	PARTS CODE	PRICE RANK Ja.	PRICE RANK Ex.	NEW MARK	PARTS RANK	DESCRIPTION	
1	0AP5381946101	E C	A L	N	B	TTL iC	TTL iC 74LS00P
2	0AP5381946102	E C	A L	N	B	TTL iC	TTL iC 74LS02P
3	VHiHD7404P/-1	D R	A G	N	B	TTL iC	TTL iC 7404P
4	0AP5381946104	E C	A L	N	B	TTL iC	TTL iC 74LS08P
5	0AP5381677101	F T	A W	N	B	TTL iC	TTL iC 7414P
6	0AP5371437101	E X	A R	N	B	TTL iC	TTL iC 7406P
7	0AP5371437102	E X	A R	N	B	TTL iC	TTL iC 7407P
8	0AP5381577101	E X	A R	N	B	TTL iC	TTL iC 7438P
9	0AP5371024101	E X	A R	N	B	TTL iC	TTL iC 7474P
10	0AP5371444102	F L	A U	N	B	TTL iC	TTL iC 74123P
11	0AP5434591-1/	E X	A R	N	B	TTL iC	TTL iC 75477P
12	0AP5381691-1/	F S	A W		B	リニアiC	Linear iC HA1807
13	0AP5573000-2/	F L	A U	N	B	リニアiC	Linear iC HA1127
14	0AP5422318-1/	G V	B F		B	リニアiC	Linear iC HD10310B
15	0AP5371456-1/	F L	A U		B	リニアiC	Linear iC MG1414L
16	0AP5434567-9/	L M	B M	N	B	LSi	LSi MB14021P
17	0AP5422430-1/	H M	B L		B	LSi	LSi MB14227/P
18	0AP5427288-1/	L K	B P		B	LSi	LSi MB14277/P
19	0AP5422424-1/	G V	B F		B	ハイブリッドiC	Hibrid iC DATA SS
20	0AP5434570-1/	H W	B K	N	B	ハイブリッドiC	Hibrid iC PA8146 (W-AMP)
21	0AP5434571-1/	T J	B X	N	B	ハイブリッドiC	Hybrid iC PA8145 (VFO)
22	0AP5427442-1/	F L	A U		B	レギュレーター	Regulator HA17815P
23	0AP5571325-2/	F L	A U	N	B	トランジスター	Transistor 2SA537AHB
24	0AP5369117-3/	E C	A L		B	トランジスター	Transistor 2SC1707AHB
25	0AP5573505-2/	E C	A L		B	ダイオード	Diode A35DHD
26	0AP5573505-2/	E C	A L		B	ダイオード	Diode A35DHD
27	0AP5573505-2/	E C	A L		B	ダイオード	Diode A35DHD
28	0AP5381610-8/	E C	A L		B	ツェナーダイオード	Zener diode HZ5HB2
29	0AP5381610-8/	E C	A L		B	ツェナーダイオード	Zener diode HZ5HB2
30	0AP5363050-13	E C	A L	N	B	ツェナーダイオード	Zener diode AW01-16
31	0AP5377052-18	E X	A R	N	C	チョークコイル	Choke coil 22UHJ
32	0AP5377052-38	E W	A R		C	チョークコイル	Choke coil 200UHJ
33	0AP5427440-1/	F T	A W	N	C	ターミネータ	Terminator 220ohms+330ohms
34	0AP5371172-14	E C	A L		B	抵抗	Resistor module 22Kohms×7
35	0AP5371172-68	E C	A L		B	抵抗	Resistor module 360, 620, 10Kohms
36	0AP5371172-42	E C	A L.		C	抵抗	Resistor module 220Kohms×4
37	0AP5371172-26	E C	A L		C	抵抗	Resistor module 1Kohm×7
38	0APJ23101223/	E C	A L		C	抵抗	Resistor 1/4W 22Kohms F
39	0APJ23101300/	E C	A L	N	C	抵抗	Resistor 1/4W 30ohms F
40	0APJ23101101/	E C	A L	N	C	抵抗	Resistor 1/4W 100ohms F
41	0APJ23101821/	E C	A L	N	C	抵抗	Resistor 1/4W 820ohms F
42	0APJ23101133/	E C	A L	N	C	抵抗	Resistor 1/4W 13Kohms F
43	0APJ23101470/	E C	A L	N	C	抵抗	Resistor 1/4W 47ohms F
44	0APJ23101620/	E C	A L		C	抵抗	Resistor 1/4W 62ohms F
45	0APJ23101221/	E C	A L		C	抵抗	Resistor 1/4W 220ohms F
46	0APJ23101331/	E C	A L		C	抵抗	Resistor 1/4W 330ohms F
47	0APJ23101102/	E C	A L	N	C	抵抗	Resistor 1/4W 1Kohm F
48	0APJ23101112/	E C	A L	N	C	抵抗	Resistor 1/4W 1.1Kohms F
49	0APJ23101512/	E C	A L	N	C	抵抗	Resistor 1/4W 5.1Kohms F
50	0APJ23101622/	E C	A L		C	抵抗	Resistor 1/4W 6.2Kohms F
51	0APJ23101153/	E C	A L	N	C	抵抗	Resistor 1/4W 15Kohms F
52	0APJ23101303/	E C	A L	N	C	抵抗	Resistor 1/4W 30Kohms F
53	0APJ23101513/	E C	A L	N	C	抵抗	Resistor 1/4W 51Kohms F

NO.	PARTS CODE	PRICE RANK Ja.	PRICE RANK Ex.	NEW MARK	PARTS RANK	DESCRIPTION	
54	0APJ23101152/	E C	A L	N	C	抵抗	Resistor 1/4W 1.5Kohms F
55	0APJ23101132/	E C	A L		C	抵抗	Resistor 1/4W 1.3Kohms F
56	0APJ23103620/	E C	A L	N	C	抵抗	Resistor 1/2W 62ohms F
57	0APJ23103101/	E C	A L	N	C	抵抗	Resistor 1/2W 100ohms F
58	0APJ23103302/	E C	A L	N	C	抵抗	Resistor 1/2W 3Kohms F
59	0APJ17201510/	E C	A L		C	コンデンサー	Capacitor 50V 51PF J
60	0APJ17201560/	E C	A L		C	コンデンサー	Capacitor 50V 56PF J
61	0APJ17201201/	E C	A L	N	C	コンデンサー	Capacitor 50V 200PF J
62	0APJ17212431/	E X	A R	N	C	コンデンサー	Capacitor 50V 430PF
63	0APJ17202102/	E C	A L	N	C	コンデンサー	Capacitor 50V 1000PF J
64	0APJ17202392/	E C	A L	N	C	コンデンサー	Capacitor 50V 3900PF J
65	0AP5574044101	E W	A R		C	コンデンサー	Capacitor 100V 0.001μF J
66	0AP5574044105	E C	A L		C	コンデンサー	Capacitor 100V 0.0022μF J
67	0AP5574044301	E C	A L		C	コンデンサー	Capacitor 200V 0.047μF J
68	0APJ13611224/	E C	A L		C	コンデンサー	Capacitor 200V 0.22μF K
69	0AP5371150−2/	E C	A L		C	コンデンサー	Capacitor 35V 0.15μF M
70	0AP5371150−12	E C	A L	N	C	コンデンサー	Capacitor 16V 10μF M
71	0AP5371159−16	E C	A L		C	コンデンサー	Capacitor 25V 10μF
72	0AP5371159−30	E C	A L	N	C	コンデンサー	Capacitor 50V 10μF
73	0AP5371159−3/	E C	A L	N	C	コンデンサー	Capacitor 10V 33μF
74	0AP5371159−4/	E C	A L	N	C	コンデンサー	Capacitor 10V 47μF
75	0APJ17101104/	E C	A L		C	コンデンサー	Capacitor 50V 0.1μF
76	0AP5430109223	E C	A L	N	C	コンデンサー	Capacitor 50V 0.022μF
77	0AP5430109223	E C	A L	N	C	コンデンサー	Capacitor 50V 0.022μF
78	0AP5430109223	E C	A L	N	C	コンデンサー	Capacitor 50V 0.022μF
79	0AP5430109223	E C	A L	N	C	コンデンサー	Capacitor 50V 0.022μF
80	0APJ17102155/	E C	A L	N	C	コンデンサー	Capacitor 25V 1.5μF
81	0AP5381918−2/	E C	A L		C	ジャンパーコネクター	Jumper connector, 2pin header
82	0AP5381918−3/	E C	A L	N	C	ジャンパーコネクター	Jumper connector, 3pin header
83	0AP5381918−6/	E X	A R	N	C	ジャンパーコネクター	Jumper connector, 6pin header
84	0AP5381918−16	F S	A W		C	ジャンパーコネクター	Jumper connector, 16pin header
85	0AP5381918102	E C	A L		C	ジャンパーコネクターソケット	Jumper connector socket
86	0AP5381918102	E C	A L		C	ジャンパーコネクターソケット	Jumper connector socket
87	0AP5434599−1/	G R	B C	N	C	ターミネータソケット	Terminator socket 16pin
88	0AP5393931−6/	F L	A U	N	C	コネクター	Mini py connector 16pin header
89	0AP5414098−44	E X	A R	N	C	コネクター	Modu-2 connector 8pin header
90	0AP5414098−48	G V	B E		C	コネクター	Modu-2 connector 30pin header
91	0AP5371300999	G C	A Z	N	C	コネクター	Non strip connector 50pin header
92	0AP5434584−1/	E C	A L	N	C	コネクター	Ei connector 7pin header
93	0AP5381921−1/	E C	A L	N	C	テストピン	Test pin
94	0AP5264474−1/	E C	A L	N	C	ターミナル	Terminal stud
95	0AP5568721−1/	E C	A L	N	C	ワッシャー	Transistor washer
96	0AP5291359−1/	E C	A L		C	ワッシャー	Transistor washer